Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLIV.—No. 3993] LONDON: FRIDAY EVENING, JULY 22, 1932 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

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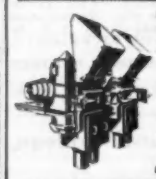

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A Seven-Day Journal

The Opening of Lambeth Bridge.

ON Tuesday, July 19th, the new Lambeth Bridge was opened by His Majesty the King, accompanied by the Queen. This bridge takes the place of the old wire rope suspension bridge built in 1862–63 to the designs of Mr. P. B. Barlow, which was totally inadequate to meet the demands imposed upon it by modern traffic requirements. It is conveniently situated to meet the needs of the office development schemes that are being carried out in Millbank. In addition. it will benefit goods traffic with the docks. The architect was Sir Reginald Blomfield, who worked in association with Mr. Topham Forrest, chief architect to the London County Council. Sir George Humphreys was responsible for the engineering side of the work, whilst the contractors were Dorman, Long and Co., Ltd., of Middlesbrough. The bridge consists of five spans; the centre span measures 165ft., the two intermediate spans 149ft. each, and the two shore spans 125ft. each, making a total length of 776ft. The deck is 60ft. wide, and consists of a 36ft. roadway and two 12ft. pathways. Amongst the main objects of the architect was to carry a continuous, unbroken surface across the bridge from end to end, avoiding the violent breaks usually caused in the silhouettes of steel-framed bridges by each of the piers. To this end a full-sized silhouette of the top of the bridge was erected on a bank at Dagenham Marshes, so as to obtain the effect of the curve of the top of the bridge as it would appear when finished. The structure contains about 4000 tons of steel, the whole of which was manufactured and fabricated at Dorman, Long and Co.'s works at Middlesbrough. The old suspension bridge had become so weakened that when work on its demolition was begun in 1929 great care had to be exercised in order to avoid a total collapse. In particular, the towers which carried the suspension ropes had to be reinforced to bear the additional load thrown upon them by the dismantling process. It is interesting to note that after about sixty-seven years of use the cables were found to possess a breaking strength of 27 tons per square inch. A full description of the new bridge was published in our issue of June 10th.

The St. Lawrence Waterway.

THE prolonged discussions concerning the development of the St. Lawrence Waterway were ended by a treaty signed on Monday by Canada and the United States. The primary purpose of the treaty is to provide for the construction of a canal on which ocean-going ships and heavy-draught lake cargo boats may voyage uninterruptedly up and down the Great Lakes and the St. Lawrence Waterway. The dams necessary to the development of the navigation system will incidentally make available vast supplies of hydro-electric power. The treaty deals only with the international section, in which there is a drop of 85ft. in the river. The two-stage plan urged by Canada, and eventually adopted by the United States, will involve the building of two big dams, one with a head of 25ft. and the other with a head of 60ft. at Crysler Island and Barnhart Island respectively. On this section there will be two navigation canals, of which that on the Canadian side at Crysler Island will be built and financed by Canada, as will be the ancillary rehabilitation works. Upon their completion Canada will own and operate these canals free from any control by the United States. Upon the same terms, the United States will build locks and rehabilitation works on the American side at Barnhart Island. An agreement with Ontario, which is to be signed immediately, secures for the Hydro-Electric Commission of that province roughly 1,000,000 horse-power to be developed on the Canadian side. Whilst gratification may reasonably be felt at this outcome of international negotiation, it must be borne in mind that ratification of the treaty by the United States Congress, which will not sit again until December, has become a political issue, dependent entirely upon the results of the forthcoming Presidential election.

Fire at the Ocker Hill Power Station.

ON Saturday, July 16th, a somewhat serious fire occurred at the Ocker Hill power station of the West Midland Joint Electricity Authority. The trouble appears to have originated in the compound-filled switchgear situated on the first floor of the annexe to the main turbine-room, and the fire resulted in considerable damage to the works power transformers on the ground floor immediately below. The switchgear controls the 7000-volt supply to these works transformers and other high-tension circuits in and around the station. As far as can be ascertained, the failure was either due to a breakdown on an instrument transformer or to a failure of the bus-bars. The internal explosion which evidently took place blew off one of the cable-boxes, thus exposing the bus-bar chamber, and the blazing compound which ran out of it passed through the cable slots in the floor and set fire to the works power transformers in the room below. Because of the nature of the buildings and the efforts of the local fire brigades, the fire was mainly confined to the works switchgear building, but, owing to the fact that the flames passed through certain openings in the turbine-room, damage was also done to cables and low-tension switchgear nearby. On account of the interconnection between the Ocker Hill station and other stations owned by the Authority at Wolverhampton and Walsall, the occurrence resulted in an interruption for only 8 minutes in the bulk supply to the Midland Electric Corporation for Power Distribution, Ltd. Although the Ocker Hill station was rendered inoperative, temporary arrangements made during the week-end enabled it to be put into service again on Monday morning. In the meantime the service was fully maintained from the other stations.

Preservation of Instruments of Historical Importance.

IN recent numbers of the lay Press letters have appeared over the signatures of Lord Rutherford and others asking for the co-operation of anyone possessing pieces of apparatus likely to be of historical importance. In 1925 the Institute of Physics appointed a committee to advise on the preservation of such apparatus. This committee is now anxious to trace any pieces with which fundamental research in physical science has been carried out, and to arrange for their preservation. The committee has also entered upon the task of drawing up a catalogue of such pieces. Several instruments of great historical importance have already been secured for the nation, and are now housed in the Science Museum at South Kensington, and the response to the letters recently published has brought to light several others. Articles describing and cataloguing such pieces are published from time to time in the *Journal of Scientific Instruments*. Any of our readers who may have had or now have such apparatus in their possession or under their charge should communicate with the Secretary of the Institute of Physics, 1, Lowther-gardens, Exhibition-road, London, S.W. 7.

The British Electric Transformer Company.

WITH their report for 1931 the directors of the British Electric Transformer Company have circulated proposals for the amalgamation of the transformer business of Crompton-Parkinson, Ltd., with that of their company, which suffered a further loss during the year which the report covers. There is now a total debit balance on profit and loss account of £89,512; the bank overdraft is shown in the balance sheet at £119,456; and the preference dividends are unpaid for the 3½ years ended December 31st last. In accordance with the proposals, the issued capital is to be reduced from £625,000 to £190,625 by writing off 10s. from each pound preference share and 17s. 6d. from each ordinary pound share. The capital as reduced is then to be consolidated into one class of preference share at £1 each, carrying a 5 per cent. cumulative dividend as from January 1st next. These shares will be guaranteed by Crompton-Parkinson, Ltd., whose transformer business is to be acquired by the Transformer Company as from July 1st last, in exchange for the allotment of 40,000 ordinary shares of 5s. each, credited as fully paid, and these shares will constitute the total ordinary capital and carry future control. The terms advanced to the existing preference shareholders are that they should forego all accrued dividends on the existing preference shares, and accept a conversion into new fully paid 5 per cent. cumulative preference shares of £1 each, in the ratio of one new share for every two shares held. The terms advanced to the existing ordinary shareholders are that they should accept a conversion of their existing ordinary shares into new fully paid 5 per cent. preference shares of £1 each in the ratio of one new share for every eight shares held. In order to deal with the bank overdraft and other pressing liabilities and to provide adequate working capital, it is estimated that it will be necessary to raise £220,000. In the event of the scheme being adopted, the company's bankers have agreed to advance this sum secured by debenture, with provision for the gradual liquidation of the amount over a period of years. The only alternative to the scheme, the directors state, is the winding up of the company.

Gas Lighting in London.

THE Westminster City Council has accepted the tender of the Gas Light and Coke Company for the lighting of about 55 miles of the streets under the city's jurisdiction for a period of fifteen years, commencing January 1st, 1932. The previous contract with the company lapsed last December, and after negotiations with gas and electric undertakings the Council has decided to continue the use of gas. The company first carried out the lighting of Pall Mall in 1812, and has continued to light Westminster's streets for the past 120 years. Forty-seven local authorities in the London area use gas for street lighting, twenty-two prefer electricity, whilst thirty-five use partly the one and partly the other system. Some 3099 gas lamps are involved in the new contract. The existing high-pressure lamps are mostly of 1000 to 1800 candle-power, and the low-pressure lamps of 180 to 300 candle-power. The contract contemplates improvements and involves the conversion of eight lamps at the east end of Piccadilly from 1800 candle-power to 3000 candle-power; the provision of twelve centrally suspended lamps of 1800 candle-power in Charing Cross-road between Cambridge-circus and Oxford-street; doubling the candle-power of one-half of the 180 candle-power lamps; converting about three hundred low-power lamps in certain secondary main streets to 500 candle-power, and about ten to 700 candle-power; and scrapping and replacing obsolete types of columns. The net result of these improvements will be to increase the aggregate candle-power of the gas lighting by about 28 per cent.

End of the Manchester Steam Users' Association.

ON Friday of last week it was made known that the Manchester Steam Users' Association, which has done pioneer and useful work for over seventy-seven years, has terminated its separate existence and has merged its interests with those of the British Engine, Boiler, and Electrical Insurance Company, Ltd., which company will take over the Association's liabilities, its staff, and its pension arrangements. The Association was founded in 1854 by Sir William Fairburn, Bart., M. Inst. C.E., F.R.S., Sir Thomas Bazley, Bart., Sir Joseph Whitworth, Bart., M. Inst. C.E., F.R.S., Mr. Henry Houldsworth, and other gentlemen for the purpose of preventing steam boiler explosions by competent scientific inspection of boilers. The first inspector was the late Mr. R. B. Longridge, who in 1859 proposed the issue of an insurance policy as a guarantee of efficient boiler inspection. The Committee of the Association did not, however, agree with this proposal, and Mr. Longridge forthwith started the first boiler insurance company, now the Vulcan Boiler and General Insurance Company, Ltd., of Manchester. The annual memorandums of the Chief Engineer of the Manchester Steam Users' Association, notably those of Mr. C. E. Stromeyer, M. Inst. C.E., were, over many years, eagerly read as important contributions to the theory and practice of boiler operation. These memorandums were ably continued by the late Dr. Telford Petrie, who followed Mr. Stromeyer, and by Mr. V. B. Harley-Mason, his successor.

An Anglo-Canadian Iron and Steel Agreement.

ON Tuesday, July 19th, the eve of the Ottawa Conference, it was announced by Sir William Larke, director of the National Federation of Iron and Steel Manufacturers, and a member of the British steel delegation, that an agreement had been reached with Canadian iron and steel manufacturers which will be submitted to the respective Governments for discussion at the Imperial Conference. For the time being no details of the agreement are to be published, but it is understood that British and Canadian steel makers have adopted a common policy which will promote industry in both countries. For an account of the pioneer work which has been done by the British Steel Export Association and its manager, Mr. Julian Piggott, our readers may be referred to an article published in THE ENGINEER of January 29th, 1932, which gave particulars of the investigation made by Mr. Piggott into Canadian steel trade conditions and the suggestions made for close co-operation between British and Canadian steel interests.

The Accelerated Train Services.

THE London, Midland and Scottish locomotive running department successfully accomplished on Monday, the 18th, the three new records it set out to achieve. The 9.45 a.m. Manchester to Euston, which used to have 3 h. 30 min., was given the revised timing to arrive at Euston in 3 h. 15 min., with a non-stop run, as before, of 177 miles between Wimslow and Euston. The train was drawn on Monday by engine "No. 6165," and arrived at Euston at 12.54. The 5.20 p.m. from Liverpool used to be due at Euston at 9.5 p.m., with a call at Crewe. The revised timing is:—Depart Liverpool, 5.25; call at Crewe and Willesden; and due Euston, 8.45. On Monday, drawn by "Hector," it arrived at 8.39. The up and down "Royal Scot" have been accelerated by 15 min., and run non-stop between Euston and Carlisle engine sheds in each direction. The down train on Monday had a load of fourteen coaches, equal to 412 tons, and was drawn to Carlisle by engine "No. 6100." It arrived at Kingmoor shed, north of Carlisle Station, 4 min. early. On the up journey, engines are changed at Upperby shed, south of Carlisle Station. The load was thirteen coaches, equal to 393 tons, and was drawn from Carlisle by engine "6136." It left there 2 min. early and arrived Euston 5.37, 3 min. early. The L. and N.E. "Flying Scotsman" resumed its non-stop run between King's Cross and Edinburgh, on the revised overall timing of 7 h. 30 min., instead of 8 h. 15 min. On Monday the down train, drawn by the "Flying Scotsman" engine "No. 4472," with a load equal to 383 tons, arrived at Edinburgh at 5.26½ p.m.; the up train, drawn by engine "No. 2795," "Call Boy," with a load of 315 tons, arrived at King's Cross at 5.29 p.m.

The Economics of Urban Electric Railways.

By HENRY WATSON.

No. I.

OPERATING COST OF ELECTRIFIED SUBURBAN LINES.

THOUGH there is a considerable literature available on the subject of railway electrification, there is very little which treats of the economic aspect of urban electric railways sufficiently clearly and definitely to enable one to comprehend the financial problems involved in providing such facilities. Much on this subject is too vague to permit drawing definite conclusions, or deals with aspects of limited practical value, *e.g.*, choice of systems.

The purpose of these articles is to indicate the traffic requirements of electrified railways and of new electric railways to ensure financial success. Estimates have been drawn up in respect of (1) electrifying an existing steam-operated suburban railway, (2) operating a new electric surface railway in open country adjacent to a large city, and (3) operating a new underground railway of the London tube type. In the first case, estimates are prepared in respect of (*a*) a steam service; (*b*) an electric service, showing no improvement in speed or frequency; (*c*) a faster electric service, and finally, (*d*) a faster and more frequent service. In this way the effect of demanding a higher standard of service from electric traction is made more apparent.

The estimates are based on data extracted from the annual reports of the Southern, Metropolitan and Underground Railway Companies, from data kindly placed at the writer's disposal by the latter, and from information and advice provided by an engineer continuously engaged on electrification schemes.

General Values Used.—For the purposes of subsequent estimates the following assumptions apply :—

Rate of Interest on capital (Government guarantee)	5 per cent.
Depreciation—covered by equal annual contributions to a sinking fund accumulating at (21 years = 2·8 per cent.; 30 years = 1·5 per cent.; 37/40 years = 1 per cent.)	5 „ „
Life of all rolling stock	30 years
„ „ „ electric track equipment	21 years
„ „ „ sub-stations and equipment	30 and 21 years
Period to amortize construction cost	40 years
Cost of current : H.T. at power station	0·5d. per unit
D.C. at sub-stations :	
(*a*) With 20-minute rush service	0·9d. „ „
(*b*) With 10 minute rush service	0·75d. „ „
(*c*) With tube service	0·7d. „ „

These assumptions may be discussed briefly before proceeding.

Rate of Interest.—Many new electric railway facilities have been provided of recent years under the terms of the Trades Facilities Act, whereby the Government guarantee or subsidise the return on the capital involved.

This has applied to the construction of new surface and tube railways and to suburban electrification. With a Government guarantee money can be raised at 4½ to 5 per cent. Municipalities can also secure these rates either directly or by guarantee. So much construction having had the benefit of this assistance, we may assume 5 per cent. throughout.

Depreciation.—These estimates do not conform to general railway accounting methods, but make full provision for protecting capital against obsolescence, in respect of all assets, by operating a cumulative sinking fund, covering not only rolling stock and electrical equipment, but all civil engineering works. The expenditure on the latter is to be recovered in forty years by a 1 per cent. sinking fund contribution. Conservative though this may appear, in relation to past railway practice, experience shows that less than this can hardly be regarded as sound financing, when transport developments cause even whole railway routes to become obsolete.

A life of thirty years is commonly allowed for locomotives and coaches, whilst an allowance of twenty-one years for electrical equipment is fair.

Cost of Current.—High-tension current is commonly available, at large power stations, for about ½d. per unit, provided the load is of fair magnitude, and of not appreciably less than 40 per cent. load factor. One large railway company purchases at or about this figure, and, though a lower cost is sometimes discussed, anything less cannot be relied on for our purposes. Sub-stations and H.T. cables are assumed to belong to the supply authority, so that the cost of D.C. includes transmission, conversion, and financial charges. These costs must increase, per unit supplied, with decreasing frequency of service, as the distributing equipment is then less effectively loaded. Our figures vary from 0·7d., with the very frequent service needed on a tube railway, to 0·9d. where the rush-hour service amounts to but one train every twenty minutes. Large tramway systems obtain their D.C. for 0·75d. to 1d. per unit, including all charges up to the sub-station. Detail estimates, too lengthy for reproduction here, confirm the adequacy of these figures, for a reasonably efficient distribution.

We may now discuss the basis of an estimate of the cost of operating an electrified suburban railway.

System of Electrification.—A third rail, 600-volt system is contemplated, though a 1200-volt one, employing overhead distribution, would be slightly more economical for the less frequent services here postulated, a more costly distribution and train equipment then being offset by fewer sub-stations. This aspect is not, however, of great moment for our purpose.

Service Contemplated.—A railway 20 miles long is provided with stations at every mile and a-quarter, and is supposed to provide a twenty-minute rush and a thirty-minute slack hour steam service. The former period is regarded as extending over six hours, the latter over twelve hours. During rush periods, eight-coach, compartment-type trains are run, these being halved thereafter. Estimates B and C provide for electric working, first, at the same speed and frequency and, secondly, at a higher speed, whilst estimate D provides for a quarter of an hour service all the day.

TABLE I.—*Comparative Estimate of Cost of Operating a Suburban Railway by Steam and by Electricity : Assumptions.*

Length of route, double track, 20 miles	
Average distance between stations, 1¼ miles	
Estimate A : Cost of operating by steam	
„ B : „ „ electricity, with an unimproved service	
„ C : „ „ electricity, with improved speed only	
„ D : „ „ electricity, with improved speed and frequency	
Cost of locomotive (0–6–2 tank), £4000	
Cost of eight-coach steam train, excluding locomotive, £16,000	
Cost of eight-coach electric train : Estimate B, £23,000 ; estimates C and D, £28,000	
Cost of track equipment, &c., £10,000 per mile of route	
Cost of all rolling stock—Estimate A, £232,000 ; estimate B, £230,000 ; estimate C, £210,000 ; estimate D, £280,000	
Cost of all track equipment, &c., £200,000 lot	

With electric working it is practicable to demand a relatively more frequent service in slack hours of shorter trains than with steam working, as the operating costs of electric trains are more nearly in proportion to their length. With steam services the slack hour interval may be very long, whilst an electric service is more likely to show a higher frequency of shorter trains. For simplicity, however, an equality is assumed in the ratio of slack to rush service.

Average Speed.—With stops 1¼ miles apart, smartly operated, steam services can show an average speed of 18 m.p.h., including intermediate stops, whilst high-powered electric trains will make about 25 m.p.h. But the inclusion of terminal, or lay-over times, reduces both figures appreciably, in these estimates, to 15 m.p.h. and 20 m.p.h. respectively.

Lay-over Time.—The time spent at terminals must be such as, added to the travelling time, makes the round trip time for go and return an exact multiple of the service interval. The estimates happen to give rather long lay-overs to the electric trains, especially as regards the suburban terminal. Where locomotives cannot take out the train they brought in, as at busy city terminals, their lay-overs are doubled and their average speed falls.

Spare Stock.—Given the average speed with lay-over, the route mileage and service interval, the number of trains required in service can be found. If the round trip time is two hours, a quarter-hour service each way needs eight trains. Spare trains are needed to cover defective ones, routine day-time inspection, and annual overhauling and painting. An allowance of up to 20 per cent. is appropriate for electric trains.

Annual Mileage.—Annual mileages of 80,000 per set of eight coaches in stock, are common with suburban electric trains making high schedule speeds and relatively frequent midday services. But with steam locomotives so much day time is spent in cleaning, coaling, firing, boiler washing, and overhauling, that an annual mileage of over 30,000 is not to be anticipated. This will mean that as many locomotives may be out of action in rush hours as are operating then.

Average Train.—The proportion of annual mileage run with eight coaches as against four, yields the average number of coaches per train, and then the average weight of a train. Thus, in estimate D, only 28·5 per cent. of the total mileage is run with eight coaches, as the midday service of four coaches is maintained at the rush-hour frequency, only the length of train then being increased. There are 5·14 coaches per train on the average, and the average weight is 167 tons, being 260 in rush and 130 in slack hours.

Current Consumption.—Suburban electric trains, making 25 m.p.h. with stops 1¼ miles apart, will take about 65 watt-hours per ton-mile, or 6½ units per train-mile with 100 ton trains, at the train. Allowing for losses in distribution, shunting, making up time, we may estimate on 80 watt-hours per ton-mile at the sub-station D.C. bus-bars. Railways with more frequent stops or long gradients will demand a higher value.

Cost of Track Equipment.—The cost of electrical track equipment is taken at £10,000 per mile of double track. This should be ample, as the cost of equipping a mile of single track with third rail and bonding the running rails seldom exceeds £2000. There is thus a good margin to cover incidentals, such as equipping sidings, providing L.T. cables and jumpers, switch cabins, additional fencing and repair sheds, longer platforms, replacing D.C. track circuits, altering the signalling, &c.

Cost of Trains.—All rolling stock is allowed as new, it being assumed that the existing steam stock can be incorporated or scrapped, without, on the one hand, reducing the cost of providing electrified stock, or, on the other, of burdening the scheme with unextinguished capital liabilities. That is, if steam coaches are converted, they are debited at the cost of a new train less cost of conversion. Generally, a lower cost than this is possible, but, on the other hand, a scheme of electrification may accelerate the programme of locomotive renewals somewhat unduly, and interest charges may have to be carried in respect of temporarily redundant locomotives. This is seldom an important factor, however, in the final operating expenses.

Steam trains are allowed at £16,000, plus £4000

TABLE II.—*Comparative Estimate of Cost of Operating a Suburban Railway : Service Basis.*

	Estimate A.	Estimate B.	Estimate C.	Estimate D.
Service interval for six rush hours, minutes	20	20	20	15
„ „ twelve slack hours, minutes	30	30	30	15
Number of coaches per train, rush hours	8	8	8	8
„ „ slack hours	4	4	4	4
Average speed, excluding layovers, miles per hour	18	18	25	25
„ including layovers, miles per hour	15 & 16	15 & 16	20	20
Layover at each terminal, minutes	13 & 8	13 & 8	12	12
Round trip time with layovers, minutes	160 & 150	160 & 150	120	120
Trains in service, rush hours	8	8	6	8
„ „ slack hours	5	5	4	8
Trains in stock (eight-coach)	9½	10	7½	10
Spare stock over rush-hour requirements, per cent.	19	25	25	25
Train miles per week-day	1,680	1,680	1,680	2,880
„ „ Sunday	1,280	1,280	1,280	2,880
„ „ year, thousands	592	592	592	1,051
„ „ train (eight-coach) in stock	62,300	59,240	79,000	105,120
Proportion of total mileage run with eight coaches, per cent.	38	38	38	28·5
Average number of coaches per train	5·52	5·52	5·52	5·14
„ seats per train	552	552	552	514
Seat-miles per week-day, millions	0·96	0·96	0·96	1·54
„ „ year, millions	327	327	327	540
Weight of eight-coach train, tons	200	230	260	260
Weight of average train	138	159	180	167
Current consumption at sub-station, watt-hours per ton-mile	—	50	80	80
„ „ „ units per train-mile	—	8	14·4	13·4
Miles per year per locomotive in stock	29,600	—	—	—
Number of locomotives in stock	20	—	—	—
„ motor coaches in stock	—	40	30	40
„ trailer coaches in stock	76	40	30	40
Cost of current, D.C., pence per unit	—	0·9	0·9	0·85

TABLE III.—*Comparative Estimate of Cost of Operating a Suburban Railway.*

Item.	Cost in pence per train-mile.			
	Est. A.	Est. B.	Est. C.	Est. D.
	Steam.	Slow elec.	Fast elec.	Freq. elec.
1. Traffic : Wages, running trains	8·5	3·5	2·5	2·5
2. Wages of guards, cleaning, &c.	2·5	2·0	2·0	1·3
3. Fuel and water or current (D.C.)	7·5	7·2	13·0	11·4
4. Maintenance : Locos. or motor coaches	5·0	3·0	3·0	3·0
5. Trailer coaches	3·5	2·0	2·0	2·0
6. Electric track equipment	—	1·0	1·0	0·6
7. Extra on running track	—	0·2	1·0	0·8
8. Working expenses	27·0	18·9	24·5	21·6
9. Int. and deprec.: Track equipment	—	6·3	6·3	3·6
10. Rolling stock	6·1	6·1	5·5	4·2
11. Total expenses : Train mile	33·1	31·3	36·3	29·4
12. Route mile	£4080	£3870	£4480	£6450
13. Total with double frequency	33·1	27·5	32·0	26·6

for tank locomotives. Eight-coach electric trains may cost £28,000, or, say, £23,000, if equipped for low-speed operation as provided in estimate B. Further costs of rolling stock are given in Table VII. by courtesy of the London Underground authorities.

Items in Estimate.—The items in estimate given in Table III. may be compared with those in Tables V. and VI., which are derived from the annual reports

TABLE IV.—*Details of Estimate.*

Item.	
2 ..	Includes cleaning = 1d. in estimate C
3 ..	50-lb. coal per mile at 22s. ton = 5·9d., water = ·5d., sundries = 1d.; total, 7·5d.
3 ..	8, 14·4 and 13·4 units per mile at 0·9d., 0·9d. and 0·85d. per D.C. unit
4 ..	(A) 5d. = £617 per locomotive per year; (B) 3d. = £185 per motor coach per year; (C) 3d. = £247 per motor coach per year; (D) 3d. = £327 per motor coach per year (high mileage)
5 ..	(A) 3·5d. = £114 per coach per year; (B) 2d. = £123 per coach per year; (C) 2d. = £164 per coach per year; (D) 2d. = £219 per coach per year (high mileage)
6 ..	(B) 1d. = £62 per single track mile per year; (D) 0·6d. = £66
7 ..	(B) 0·2d. = £12 per single track mile per year; (C) 1d. = £62 per s.t.m. per year; (D) 0·8 = £88 per s.t.m. per year
9 ..	5 per cent interest and 2·8 per cent. depreciation on £200,000
10 ..	5 per cent. interest and 1·5 per cent. depreciation on £232, £230, £210 and £280 thousands
11 ..	Includes all expenses incurred on trains and on electric track equipment
13 ..	Double frequency reduces items 3, 6, and 9

TABLE V.—*Analysis of Southern Railway Company's Accounts for* 1931.

Item of expenditure.	Aggregate spent in year, £ thousands.	Per vehicle or mile of route, £.	Per train mile, d.	Vehicles or miles maintained.
Traffic receipts, passenger trains	15,600	7,260	66	2148
Maintenance of way and works	3,209	1,500	10	2148
Repairs:				
Permanent way ..	1,170	545	—	2148
Electric track equipment	66·9	77*	—	875
Motor coaches	178	197	2·07	905
Coaching vehicles ..	580	68·5	—	8459
Locomotives	867	430	3·83	2016
Current, lubricants, for electric trains ..	615	—	7·15	—
Fuel, water, for locomotives	1,513	—	6·70	—
Wages running electric trains	168	—	1·96	—
Wages running steam trains	1,769	—	7·83	—
Traffic expenses ..	5,345	2,480	17·3	—

Electric trains ran 20·6 million miles. Steam locomotives ran 54·2 million miles. Own power station delivered 95·2 million D.C. units for £204,000 = 0·513d. unit, exclusive financial charges. Excludes amounts set aside into renewals funds. Mileage run per locomotive in stock, 26,900; per eight-coach electric train in stock, 95,000.

* Track mile, including signal equipment.

TABLE VI.—*Analysis of Metropolitan Railway Company's Accounts for* 1931.

Item of expenditure.	Aggregate spent in year, £ thousands.	Per vehicle or mile of route, d.	Per train mile, d.	Vehicles or miles maintained.
Traffic receipts, passenger trains	1,400	35,400	60	39½
Maintenance of way and works	141	3,570	—	39½
Repairs:				
Permanent way ..	46·3	1,170	—	39½
Electric track equipment	9·14	232	—	39½
Motor coaches	72·5	344	2·84	211
Coaching vehicles ..	42·2	85·0	—	496
Locomotives	19·9	552	5·43	36
Current, lubricants, for electric trains ..	209	—	7·55	—
Fuel, water for locomotives	32·5	—	8·85	—
Wages, running electric trains	68·5	—	2·48	—
Wages running steam trains	31·5	—	8·60	—
Traffic expenses ..	320	8,100	10·2	39½

Electric motor coach trains ran 6·13 million miles, steam trains ran 0·879 million miles, and electric locomotives ran 0·518 million miles. Own power station delivered 115 million D.C. units for £267,000 = 0·56d. unit, exclusive financial charges. Excludes amounts set aside into renewals funds.

TABLE VII.—*Cost Data Relative to London Underground Railways,* 1929.

Cost of District Railway type eight-car train, complete	£27,000
Cost of Tube Railway type seven-car train, complete	£23,750
Motor car, complete	£4,400
Control trailer, complete	£3,050
Trailer	£2,500
(Standard L.E.R. train has three M.C., one C.T., and three ordinary trailers)	
Maintenance and renewal of track per mile of route on Metropolitan District Railway ..	£2,600
Maintenance of rolling stock—	
Metropolitan District Railway, per car mile	1·54d.
Three tubes, per car mile	1·00d.
All railways, per car mile	1·17d.

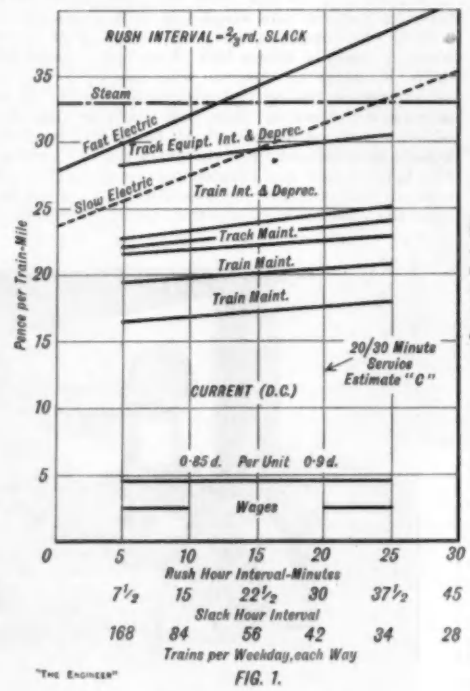
of the Southern and Metropolitan Railways for 1931. These results are of peculiar value for our purpose, because the former operate a large suburban electric service, and 75 per cent. of their train mileage is in respect of passenger trains, whilst the latter run an electric service as well as a small steam system whose operations are easily visualised.

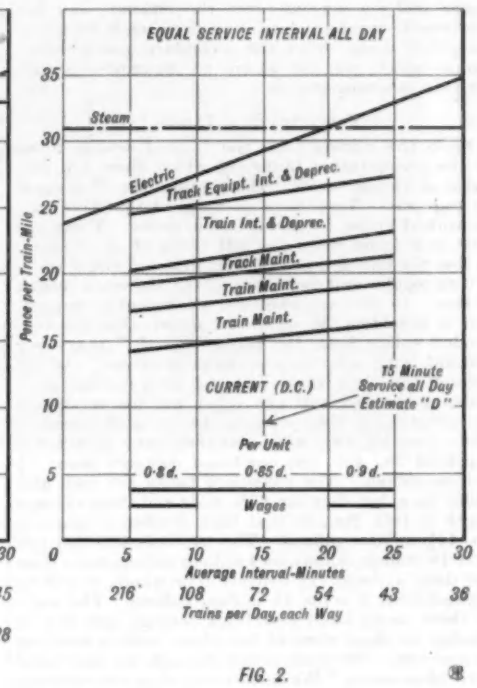
In comparing values some items are best comprehended in terms of pence per train-mile, and others are best discussed in terms of annual cost per vehicle in stock or per mile of track, &c. Details given in Table IV. permit such comparisons. Wages running trains include those incurred on locomotives and in sheds, and may vary from 8¼d. to 2¼d. per train-mile, as shown, the higher value, with steam trains, being due to low revenue mileage per man, fireman's wages, heavier cleaning and shed attention and greater dead mileage. Guards' wages and cleaning of coaches make up the second item. A charge of 7½d. for coal and water may be expected on suburban trains. The cost of current is found by multiplying the average weight of a train by the consumption in watt-hours per ton-mile. Note that it includes sub-station costs and is not just the cost of H.T current. Maintenance of locomotives at 5d. per mile yields £617 per locomotive per year, and of motor coaches, in estimate C, £247 each. Trailer coaches are well covered at 2d. per train-mile in estimate C, giving £164 per coach. Compare with £197 and £68·5 in Southern figures. Some £60 per mile of conductor rail is included for maintenance, whilst an attempt has been made to allow for the heavier depreciation of running rails involved by electric traction. Working expenses include those incurred on trains, plus those in respect of track equipment and sub-stations. Items 9 and 10 cover the financial charges on the electric track equipment and rolling stock, giving a total figure which is for providing, maintaining, running, and renewing trains, including electric track equipment and all power supply. Expenses common to steam and electric working, and unaffected thereby, are excluded.

Conclusions.—Comparing estimates A and C, it may be noted that the electric train saves 6d. on locomotive and shed wages, 3½d. on train maintenance, and 1d. on sundries, but costs 5½d. more for D.C. than coal and 8½d. more for providing and maintaining the track equipment. It will be understood that the cost of providing and running steam trains is unaffected by the service interval, since no expenses in route equipment are involved. With electric traction a doubly frequent service very nearly halves the cost of providing and maintaining the electrical track equipment, besides reducing the cost of current at the sub-station D.C. bus-bars, owing to the more efficient loading of the sub-station equipment and H.T. cables possible with a higher power demand per route mile. With a twenty to thirty minute service the sub-station installed capacity is largely determined by the requirements of starting two trains simultaneously, and it is then several times the average load. It is then hardly possible to deliver current to the D.C. bars under 0·9d. per unit.

A 25 per cent. increase of annual mileage per train reduces the cost, per train-mile, of providing rolling stock by that amount, and a 25 per cent. increase of speed similarly tends to reduce the incidence of wages and train maintenance, in terms of pence per train-mile.

The costs per train-mile, yielded by Table III., are plotted in Figs. 1 and 2, for various service intervals, and for (1) services with a slack hour interval equal to 1½ times the rush interval, and (2) for those where the same interval is maintained throughout the day, as in estimate D. These graphs warrant careful study, and show how both the total and detail items of the cost of electric train operation increase with increasing interval or decreasing frequency of service. Details of steam operating cost are not indicated. An additional broken line in Fig. 1 indicates the cost of operating a slow electric service, *i.e.*, with trains making no greater speed than the steam ones, *i.e.*, 18 m.p.h.





Thus, with medium frequencies electric traction with equal speeds is slightly cheaper, and with high frequencies even fast electric trains are likely to be more economical than steam ones. The saving is slight, however, amounting to (1) with a fast electric ten to fifteen minute service, 1d. per train-mile, or £245 per mile of route per year, and (2) with a slow electric twenty to thirty minute service, 1½d. per train-mile, or £175 per mile of route per year.

Clearly, electrification of suburban lines can rarely be regarded as a means to secure any worth-while economy, but must justify itself by attracting additional revenue with a faster or more frequent service. Yet there are certain high frequency steam services which would justify electrical operation, purely as a slow, economical service, for with ten to fifteen minute services a saving of 5½d. per train-mile is shown in Fig. 1 (27·5d. against 33d.), amounting to £1380 per mile of route annually. Since the capital cost of electrifying 20 miles of railway would be £660,000, excluding sub-stations (see estimate B with double rolling stock) the capital return on £33,000 per mile could be increased from 5 to 9·2 per cent. Thus, some of our high frequency services could be operated electrically at the same speed, whilst allowing a good return on the capital involved. Further consideration is given to these points in the next article.

(To be continued.)

IN *The Times* of July 8th Mr. R. A. H. Weight records what was, as far as his extensive experience goes, the fastest run of the up "Flying Scotsman." On Tuesday, July 5th, it left Newcastle 15 min. late, and, despite two severe checks, arrived at King's Cross 2 min. before time. The 44·1 miles between Darlington and York were covered in 43 min., with an average speed of 61¼ m.p.h., and the 105¼ miles between Grantham and King's Cross in 108 min. The engine throughout from Newcastle was No. 4472, the "Flying Scotsman."

The Sewage Disposal Works of the Bradford Corporation.

No. II. (*conclusion*).*

Mixing Tank.

The acid is added to the sewage as it emerges from the pipe lines and just before it enters a mixing tank. In this tank, which has a capacity of 445,000 gallons, the sewage is kept in circulation by being turned over by baffle boards placed across the line of flow, so that no precipitate settles. It is found that this period of travel, amounting, as it does, to about half an hour, and the turning over, result in an improved cracking of the soaps while a reduction of the colloidal matter is also obtained. The improvement in the sewage, as the result of its passage through this tank, represents, we understand, 14 per cent., measured in terms of oxygen absorbed. Laboratory experiments indicate, however, that that is not the maximum improvement possible, so that even better results may be hoped for. It has been found, too, that an increase in the suspended solids in the liquor still further improves the effluent, and for that reason arrangements have been made to pump back the sludge from the secondary precipitation tanks—which we are about to describe—to mix with the incoming sewage.

Precipitation Tanks.

From the mixing tank the treated sewage flows to the precipitation tanks, of which there are two series of twenty each. These tanks are illustrated on page 81. They were so designed that they can be worked either in parallel or in series. There are inlet and outlet weirs the full width of all of them, so that the film of liquid passing into and out of them is very regular and quiet throughout the whole length of flow. In this way excellent settlement is secured, and it is seldom, so we are informed, that the suspended solids from the tanks exceed 7 parts per 100,000, with only minute traces of grease. At the present time, one series is being used for the acid-cracking process and the other set for secondary precipitation. The primary tanks each measure 140ft. long by 60ft. wide, and they have an average depth of 7ft. 4in., the combined contents being 7½ million gallons. The secondary tanks are each also 140ft. long, but they are 65ft. wide and their average depth is 10ft. 2in., so that their combined contents are 11½ million gallons. The two sets together can hold 19 million gallons, or 4 million gallons more than the daily average dry-weather flow which, it will be remembered, is some 15 million gallons. The walls of these tanks have blue brick facings, one row of headers to three rows of stretchers, with a hearting of concrete. The walls of the channels are also faced with blue bricks. We understand that the acidified sewage has not been found to affect appreciably either the bricks or the cement joints, the greasy scum which forms on the surfaces apparently acting as an excellent protection.

The sludge from the precipitation tanks gravitates—as does that from the detritus tanks already described—in sealed mains, to a screening plant, to which reference will be made later. The effluent from the tanks passes by a conduit at the east end to the bacterial filters, a distance of 920 lineal yards. It generally possesses the following typical characteristics:—

	Parts per 100,000.
Oxygen absorbed	12·8
Grease	6·0
Suspended matter	7·4
Alkalinity	5·9
Ammonia, free	2·3
Ammonia, albuminoid	1·2

One of the difficulties met with at this stage is the growth of certain fungi, which appear to be much encouraged by the acid used for treatment. Latterly, since the P.H. value of the effluent was increased, the amount of fungus has considerably decreased. The fungi—which include *fusarium aqueductum*—are more pronounced in winter than in summer, and they thrive particularly in the length of conduit leading to the filters, which passes underground. It has been found necessary, in consequence of this growth, to pass the tank effluent through a series of three fine screens in order, as far as possible, to arrest the fungoid growths which break away from the walls and floors of the channels. The screens are also of service in preventing leaves and other extraneous matter from passing on to the bacterial filters.

The Bacterial Filters.

There are in all 53 acres of bacteria beds. The beds are in all cases rectangular, and they are divided up into units of different areas. Together, these beds deal with a dry-weather flow of 18 million gallons a day, which is equivalent to an average of 340,000 gallons per acre, 70 gallons per square yard of surface, and 35 gallons per cubic yard, the filters being 6ft. deep. In consequence, however, of the high rate of flow of sewage persisting during some ten hours of the day—as explained last week—the filters have, in actual practice, to operate ordinarily at a much higher rate. It is by no means unusual, for example, for the flow during the day to be maintained at a rate of some 30 million gallons per day for long periods, which is equivalent to 556,000 gallons per acre, 117 gallons per square yard, or 58 gallons per cubic yard. These filter beds are illustrated in a photograph reproduced on page 81.

An excellent filtering material has been found to be hard Yorkshire coal, which has proved to be particularly suitable for dealing with the particular type of sewage treated at these works. The size used varies from ¾in. to 1¼in., and is known in the trade as "washed singles." Owing to its lightness in weight, coal is a cheap form of filling material, as a cubic yard of it only weighs 11 cwt. It is therefore actually cheaper than some other materials. Coal does not appear to suffer as regards its calorific value from long continuance in the beds, and that fact is of considerable importance. During the General Strike in 1926 the whole of the gas and electrical services of Bradford were maintained at full output by means of coal obtained from the bacteria beds. In addition, factories in Yorkshire and Lancashire, as well as householders, were kept supplied with fuel, as many as 200,000 tons of fuel being disposed of in that manner. As has been said, the depth of the filtering material now employed is 6ft., but prior to 1926 the late engineer had constructed, as an experiment, 6 acres of filters 10ft. deep and 6 acres 15ft. deep, in order to observe whether there was any advantage in having the additional depth. It was ascertained, however, that with the particular type of sewage to be dealt with at Bradford, very little benefit was derived from the extra depth; certainly the benefit was not commensurate with the extra cost of material, and it was from the deeper beds that the coal for fuel was first obtained during the strike. Subsequently, the beds were remade with coal 6ft. deep.

With a view to the possible use of the coal for fuel a special form of construction of the beds is employed. The beds are all formed with flat concrete floors, 6in. thick, with channels formed in them 18in. wide and from 3in. to 21in. deep, so that these channels have a considerable "fall." The channels are covered over with concrete flags supported on blue bricks. The walls of the beds are of concrete, unlined with brickwork. The floors are made flat so as to assist in the loading and unloading of coal, and so as to allow of railway lines being slewed about on them in any direction. Openings are left in every section of the beds, so as to allow of the entry of railways and plant for the removal of the coal. Grab cranes are well fitted to handle the material, and twenty-five trucks loaded per machine in eight hours is regarded as a reasonable day's work. Twenty-five truck loads represent about 200 tons, and the cost of unloading, including levelling the coal into its final position, works out at about 9d. per ton.

The filter beds are all rectangular, and the distributors are of the balanced, reciprocating type, so that they are unaffected by wind pressure. Throughout the works as much use as possible has been made of natural forces, and these distributors are operated by overshoot water wheels, which are driven by the sewage as it makes its way from the precipitating tanks to the filter beds, there being ample fall for the purpose. The power therefore is obtained for nothing.

The distributors have automatic reversing gears and require but little attention. The troughs, of cast iron, which convey the sewage across the beds, rest on the top of the coal without any solid support, saving that at the leading end of each trough two wooden pit-props of the correct length are driven down through the coal with a mallet until they reach the concrete floor. These props prevent the troughs from settling. The nozzles in the distributors are of large diameter—$\frac{11}{16}$in.—so that they are not easily choked with fungus or other obstruction. The liquid passing through them impinges on porcelain plates, so that sprays of umbrella shape are formed and the liquid is evenly distributed over the surface of the beds. The porcelain plates are about 5in. above the top of the filtering material.

As in most other sewage works, a certain number of flies—*psychoda*—appear on the Bradford filter during the summer months. They are, however, confined to the actual filtering material, and are reported not to cause any nuisance. In no other part of the works is there any quantity of flies, and that fact, as well as the absence of smell, is attributed to the fact that there is no septic sludge in any part of the process of treatment.

Sludge Disposal and Grease Recovery.

Possibly the most interesting part of the whole treatment is the manner in which the sludge is treated. The sludge disposal buildings and works are shown in an illustration on page 82. It can, in fact, be said that Bradford has *no* sludge problem, the difficulties which have to be faced by so many sewage works having been satisfactorily overcome. They have only been surmounted, however, by patient research which has been carried on over a number of years, and by which the methods employed have been continuously improved in detail.

Reference has already been made to the troublesome nature of the Bradford sewage, with its high grease content and its varying alkalinity, and it has been pointed out that the most efficacious treatment was found to be the addition of sulphuric acid in regulated quantities. At first, lime had been used, and then other chemicals, but they turned out to be unsatisfactory and expensive, besides possessing other disadvantages, and since the year 1901 sulphuric acid alone has been employed. The acid brings about the precipitation of the solid matters which carry down with them a very considerable proportion of the fatty matters; but it does not remove those fatty matters from the sludge, and unless that were done, it would be practically impossible to dispose of the sludge, even if it could be satisfactorily dried. Moreover, if the fatty matters had been disregarded, there would have been a considerable financial loss, as the following figures abundantly show. From October, 1902, to the end of March, 1903, grease to the value of £222 was reclaimed and sold. In the following year the value had increased to £2371. In the years 1908–9 it had passed the £20,000 mark per annum. Before the war nearly £200,000 had, as an aggregate, been received from the sale of grease alone. In 1918 the enormous figure of £126,658 was reached, but that was the result of abnormal circumstances, though the sales for the years 1918, 1919, and 1920 contributed to relieving the rates to the extent of £81,453. In the first twelve years of the post-war period, the sales reached over half a million pounds sterling, and the total value of the grease produced from the outset had, by the end of the year 1931, reached the huge amount of £1,250,000. It can therefore be readily understood of what outstanding importance it was that all this grease should be salved, and the importance is all the greater when it is realised that the abstraction of the fat turned the sludge from a material which it would be very difficult to get rid of into a valuable manure which finds a ready sale and fetches good prices.

The sludge as it leaves the precipitation tanks has a water content of from 80 to 83 per cent. It gravitates to a screening plant—illustrated on this page—where it meets and is mixed with gritty sludge from the detritus tanks, as it has been found that such admixture is an advantage not only in the salving of the grease, but in the production of saleable manure. The proportion employed is 1 to 6, and the mixture of acidified sludge and grit is lifted to the sludge disposal building, where it is passed to large 7-ton vats, where it is heated by means of steam coils, the temperature being raised as high as possible. As a matter of fact, 170 deg. Fah. is about as high as it can usually be taken in practice, for above that point the liquor begins to froth. When at the required

FIG. 8—SLUDGE SCREENS

* No. I. appeared July 15th.

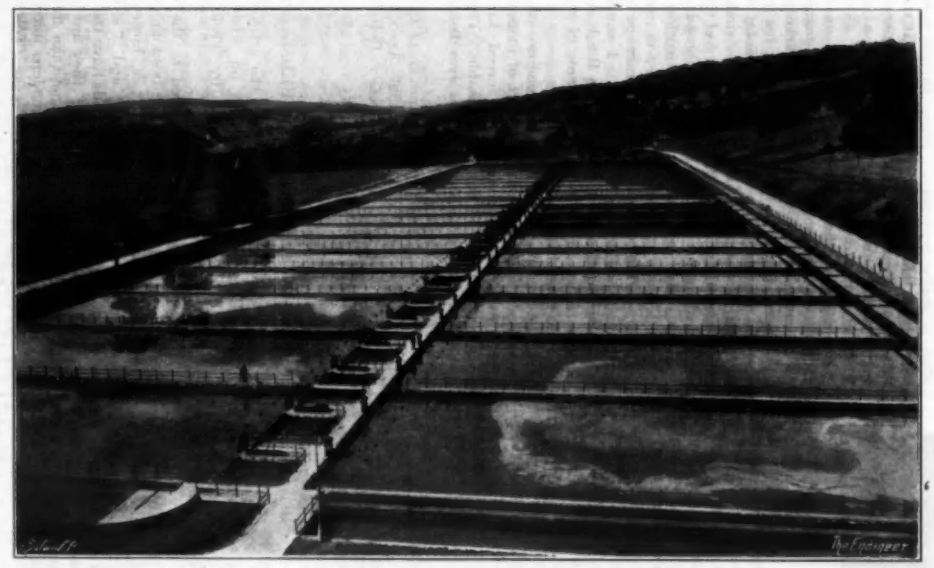


FIG. 9—PRECIPITATION TANKS

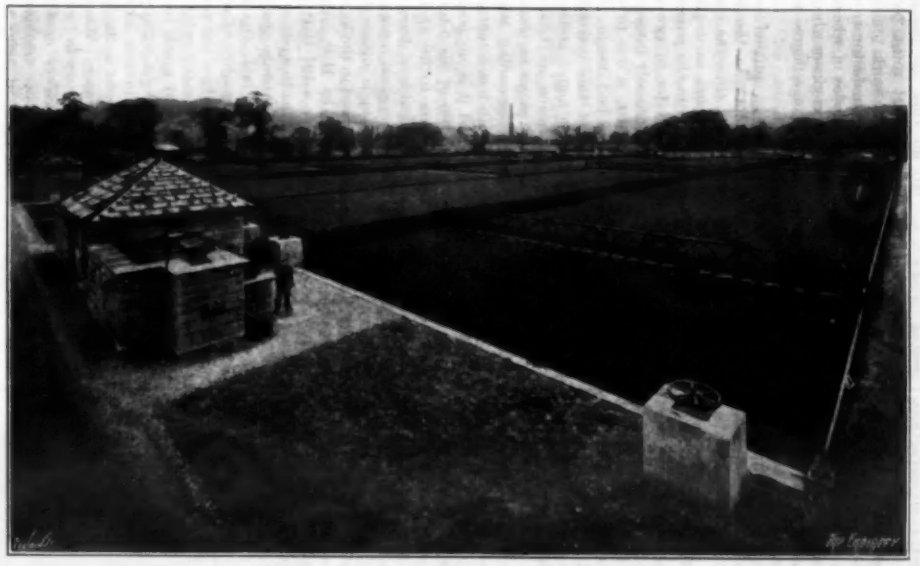


FIG. 10—BACTERIAL FILTERS

FIG. 11—PRESS HOUSE

FIG. 12—GREASE HOUSE

heat the mixture is allowed to fall into large displacement vessels, whence it is forced by compressed air to the press house, the interior of which is shown in a photograph reproduced on page 81. There are 128 presses, the cloths of which are of cotton, that material having been found, after exhaustive trials, to be the best for the purpose. The life of a filter cloth, under good conditions, is from six to eight weeks, and about 40,000 cloths are used per annum. Before the war these cloths cost from 2s. 2d. to 2s. 5d. each, and in 1924 they cost double those amounts. Now, however, the cost is at or below pre-war rates. The presses are fed with hot sludge and superheated steam alternately, so as to keep up the temperature, and liquid grease and water are discharged during the pressing process. The grease removed is delivered to vats in the grease house illustrated by a photograph reproduced on page 81. The presses are operated for varying times, according to the nature of the sludge being pressed, but a period of 64 hours is the usual practice. During that time, the grease content of the cake produced is reduced to about 16 per cent., calculated on the dry solids, as compared with 40 per cent. in the original sludge. When the water content of the cake is about 26 per cent., the presses are opened and the cake falls down into railway wagons in the basement of the press house, and is taken thence to a drying area, where it remains for some twelve months to mature. An average of about 75 tons of cake is produced daily.

While hot from the presses the cake is stored in large heaps in the open, covering buildings not being necessary as the cake is not affected by ordinary weather conditions. While maturing the amount of the grease content is reduced by the "heating" of the material, which is a chemical action connected with the growth of moulds. This heating also has the effect of melting further quantities of the grease, which tend to settle to the bottom of the heaps. At the end of twelve months or so, the heaps are broken into by grab, and the material is passed through a disintegrator, which grinds it into a fine powder that has a ready sale on the market, as the maturing process has reduced the grease content to such a small trace that the powder is nice to handle, and at the same time, is free from light dust. As a rule, an endeavour is made to send out manure with a moisture content not exceeding 15 per cent., and that figure is often down to 10 per cent. Only about 5 acres of land is set aside for the storage of the cake, and no nuisance whatever arises from it.

The sludge disposal building contains, in addition to the plant already mentioned, four Stirling water tube boilers, each designed to evaporate 15,000 lb. of water per hour. They are capable of using low-grade fuels—either slacks or a mixture of slack and pressed cake—the cake, by reason of its grease content, having a calorific value of about 7500 B.Th.U.—or liquified grease, although the last named is very rarely used.

A second plant for the extraction of grease from the pressed cake—amounting, as mentioned above, to about 16 per cent. of grease on the dry solids was laid down some years ago in a separate building. By the use of such solvents as benzine, the remaining grease may be extracted in this plant, but the process is not considered to pay unless the price of grease is relatively high, and consequently it is not usually operated.

Smells.

The effect of the acid treatment on the works largely precludes the formation of septic sewage or sludge in any part of the process, and in consequence there is a comparative absence of smells on the works as a whole. To prevent the emission of any offensive odours during the hot process of sludge disposal, each of the heating vats is covered by a hood and pipes, by which the gases are conveyed away. Stainless metal is the material used for this construction. A fan draws the gases away and passes them up a tower filled with brushwood, through which a constant stream of water falls. The gases are in this way thoroughly scrubbed. In addition, a plant has been installed to circulate ozone throughout the press house and the grease house. The ozone is allowed to escape at various points in the apex of the roof, where it mingles with the gases from the process oxidising many of the compounds having obnoxious odours.

Experimental Works.

Before closing this account, some mention must be made of the experimental work that has been carried out in the department. Particular interest belongs to the work carried out with regard to the question of activated sludge and sludge digestion, as applied to the treatment of the particular sewage met with at Bradford. Although activated sludge treatment is not used in any part of the process, its action has been investigated in many large-scale experiments. In one, the crude sewage was treated by means of air blowing in a deep cylindrical tank. This process necessitated no accumulation of sludge, as does the ordinary activated sludge process. The sewage was merely pumped into the tank and the effluent containing the sludge removed from a point two-thirds the depth of the tank. On settlement, the effluent was always found to be satisfactory from a bio-oxygen standpoint. There are drawbacks, however, to the use of the activated sludge method of treatment at Bradford. The sludge to be dealt with would be approximately ten times greater in volume and of a more difficult nature for disposal, and a large quantity of the grease content of the original sewage would be destroyed.

As far as sludge digestion is concerned, a digestion tank containing 2000 tons of sludge was in operation for long periods. The gas evolved was used for running a gas engine, 20 B.H.P. being developed. In case the process of sludge digestion should be adopted in Bradford in the future, and with a view to using the gas evolved in the manner described, suitable clauses have been inserted in the agreement with the Baildon Urban District Council. Since, however, the disposal of the sludge and water from the digestion tank presents certain difficulties, and because the grease is destroyed in the process, no advantage is expected to be found in this method.

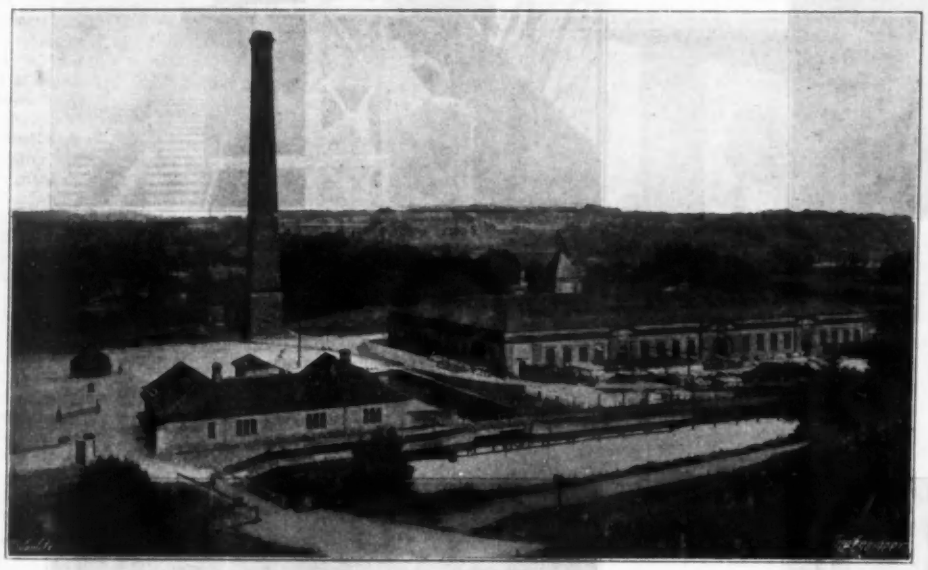


FIG. 13—SLUDGE DISPOSAL BUILDINGS

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

QUALITY AND PRICE.

SIR,—In my present position I am very interested in the leading article in your issue of June 3rd. As this discussion originated in the Argentine, I am directly interested in the question.

Mr. Bremner's letter deals with the subject in the masterly fashion which one expects from the writer and brings out some very important facts. Those of us who have spent much time in foreign countries must see Mr. Bremner's point that most of the world's work is done by machinery not to British standards, and in most cases being well done and everyone is satisfied with the results.

We must not think that a machine which is heavier than another is necessarily better, and if a machine is designed of light construction and does its work satisfactorily, then we must consider that it is a sound engineering production. To do this the design must be scientifically sound, as each part must be accurately designed to perform its part of the work.

It is said that the greatest benefactor to mankind is the man who can grow two blades of wheat where one grew before. In like measure the engineer who can produce a machine of a lighter weight is in a degree a benefactor as he is saving material.

In export business this has a further consequence, as every charge from the factory to the consumer is invariably based on weight, and thus the cost of heavy machinery becomes more and more as it travels along, and gives nothing in recompense to the purchaser.

Heavy weights are accounted for in two ways. The first, which we need not take seriously into consideration with the average British product, is due to the employment of extra material to cover bad design. The second, which is the subject matter of this correspondence, is due to working to unnecessarily high standards.

In taking cranes as an illustration, as these are referred to originally, we can see many ways in which weight is added to weight with no corresponding benefit to the user. If each member of the jib has a margin, then the jib itself has a greater one, and it is no possible benefit to the user to know that the jib of his 5-ton crane will lift 7 tons when he never wants to lift this weight, or if the electric motor itself is incapable of doing so.

If British standards call for too great margins or factors of safety, then to work to them is ultimate suicide to industry, and they should be revised in the light of modern conditions. Anyone buying a 10 H.P. electric motor to-day does not expect to receive a 12½ H.P. one, and he will not pay more for one which has this power.

This question of standards is entirely apart from that of quality of workmanship. In fact, the less margin there is in design the higher the quality of workmanship required. I think too much is made of the safety against accidents. In England there are many rules and regulations which have forced us to add much to the cost of design and production to protect us against a remote contingency. Such regulations do not exist in other countries, and when they are enforced in the home market it adds much to the cost of production. When the maker tries to sell this same type of machinery in foreign markets with these same protective or safety devices, he finds his price prohibitive as against other machines which are not so equipped and which are in many cases neither necessary or useful.

In English practice we make a fetish almost of freedom from accident or failure. It is a fact that many of our own public utilities have to undertake very heavy expenditure to guard against a remote possibility of failure, in many cases to safeguard against some possible failure which has never yet occurred. Our railways are a case in point, and if these are compared with American railways, it is easy to see the explanation of high freight charges.

We learn much by our failures, and if we start out by trying to safeguard against any possibility of them, then we never really find out how much we are in excess of what is really necessary. Many British standards call for margins which can never be utilised. It seems absurd to couple a dynamo with a 25 per cent. margin to an oil engine with scarcely any, or to provide a jib to stand 7 tons in a crane designed to lift 5 tons.

If British purchasers would not insist on such extravagances for the home market and for materials which they purchase at home for foreign markets, then the manufacturer will be able to redesign his products to give his customer exactly what he wants, with a fair competitive chance against the foreign maker, and in this he can still maintain that high quality of workmanship which has always been our great asset abroad.

In this the British Standards Institution can assist if it will revise its standards wherever it can be shown that they call for something which handicaps our industry as against our foreign competitors. I suggest that it might be found advantageous if the B.S.I. would invite representatives of the sales departments of our manufacturers to attend its revising meetings.

At the present time these questions are of the utmost importance. All countries are short of money for capital expenditure and, therefore, are forced to make this small amount buy as much as possible. Thus, they are inclined to take greater risks than ever before and buy almost everything on a price basis.

THE BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION,
H. C. SIDDELEY, Delegado.

Buenos Aires, July 1st.

"COLLOIDAL FUEL."

SIR,—I have read with interest the articles appearing in THE ENGINEER and elsewhere on what is termed "colloidal fuel," especially that by Professor Henry Louis in THE ENGINEER.

The word "colloidal," as applied to the mixture of coal dust and oil, savours of having been coined from the two words "coal" and "oil." It is, however, derived from the Greek, "kolla=glue," and "eidos=form," and is a descriptive name, for colloids have the appearance of this gluey or flocculent matter; they are ultra microscopic particles, and although larger than molecules, are individually invisible under the modern microscope, and may be seen only as a flocculent mass. To grind coal to this degree of fineness is, as far as I know, an impossibility and, in any case, very expensive, as the cost of grinding

increases in proportion to the square of the degree of fineness.

There is much to be said for a fuel that is easily handled, burns cleanly, and is cheap to fire, but when reviewing the possibilities of the coal-oil mixture we must not overlook the progress made in the past decade in the technic of grinding and firing pulverised coal alone, and the fact that at the present day many of the world's largest power plants and several large liners are using pulverised coal economically. Its applications to industrial furnaces are many and are effecting marked economies. Experiments have been under way for some time in the application of pulverised coal to railway locomotives.

In order to get some idea of the initial cost of the coal-oil mixture as compared with coal, it is convenient to calculate the cost per million B.Th.U., and for this purpose I shall use Professor Louis' basic prices :

	Per million B.Th.U.
Coal at 13s. a ton and 14,000 B.Th.U. per pound gives	5d.
Coal-oil mixture, 40 per cent. coal as above, and 60 per cent. oil at 31s. a ton, and 19,000 B.Th.U. per pound, plus 2s. 6d. a ton for grinding, gives	8d.

Thus, we are forced to the conclusion that at the present prices of coal and oil the mixture is not economical for steam-raising purposes ; also, we must remember that coal is a 100 per cent. British product, whereas oil is mainly of foreign origin.

It therefore behoves us to keep our attention on improvements in our coal-firing equipment. At the same time we must not overlook a very important possibility. I refer to the possibility of using the coal-oil mixture in a modified form of Diesel engine. Experiments in this direction would, if successful, bring help to our coal industries.

Some ten years ago, while a pupil on the Great Central Railway Company's staff at Immingham Dock, I assisted with tests on Lancashire boilers fired with three different fuels, viz., coal, oil, and a coal-oil mixture. Fortunately, I have some of the data by me, which I give below :

	Cost of fuel per ton.	Pounds of steam per pound of fuel.	Cost of fuel to evaporate 100 lb. of steam from and at 212 deg. Fah.
Coal	19s. 9d.	7·92	1·336d.
Oil	75s.	14	2·8d.
Coal-oil mixture	47s. 6d.	9·4	2·707d.

These tests were made in 1922, and although the coal-oil mixture was successfully fired, it was not a success financially.

It is very doubtful if the mixed fuel will be able to compete with coal. It may be used with small economies on those vessels already equipped to burn oil, but its greatest future appears to lie in its use as a fuel for Diesel engines.

JOSEPH WRIGHT, A.M. Inst. C.E.

Ealing, W. 5, July 18th.

SIR,—Further to Professor Louis' article in your current issue, which is very much to the point, may I emphasise that over and above the very fine grinding of the coal advocated for the preparation of stable coal-oil mixtures, it is essential to pay some attention to the type of oil selected ? Oils with constituents very close to those of the coal in composition have much greater "wetting" and dispersory powers than those of the purely paraffin type. Viscosity and specific gravity should also be as high as possible consistent with ease of pumping.

Stabilisers need not be used if the coals and oils are properly selected and the ash and moisture content of the coal is as low as possible. So far colloidal mills have not given satisfactory throughputs at anything like reasonable cost, so that for the moment those contemplating the manufacture of coal-oil suspensions are dependent on the better types of normal pulveriser now on the market. Fortunately, the manufacturers of this class of equipment are fully alive to the possibility of large-scale developments in the near future covering the preparation and utilisation of coal-oil suspensions and can now guarantee cleaned pulverised coal of a suitable specification for the purpose.

London, S.W. 1, July 19th. JOHN L. STREVENS.

NATIONAL TRANSPORT.

SIR,—Captain Henderson, in your issue of July 15th, says that "the best and cheapest carrier for all heavy goods, including coal, is inland water transport, which depends on water, which never wears out." What are the facts ? We have between Yorkshire and Nottinghamshire coalfields and the Humber ports the best inland water transport it is possible to provide in Britain. We have unique coal carriers, towed in "trains" by efficient tugs ; wonderful locks, hoists, loading and discharging facilities. Over most of the navigation we have level country—far more level than we have in other British coalfields. We have the natural rivers Aire, Calder, and Don linking up with the artificial canals, and we have the tidal rivers Ouse, Trent, and Goole affording practically free waterway or navigation. There is nothing else in the country like this set of favourable conditions, and yet the three Humber ports of Hull, Grimsby, and Immingham receive thirty times as much coal by rail as by barge. Would that be the case if Captain Henderson's ideas were accurate or his figures of any value ? Do we have 30 tons of coal carried by rail at high cost when we have all these water transport facilities available and cheap ? Do we pay high rail rates for the fun of the thing, and deliberately reject cheap water transport ?

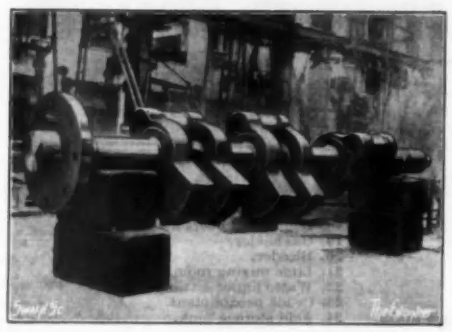
The hard fact is that only in a few selected parts of foreign countries can canal transport be economical—where land is level or nearly level, and where there are big and deep rivers to include in the network of canals. This idea of making canal transport economical in hilly Britain is a fantastic delusion. No system of canals in this country can be of service to more than a small minority of our traders. Not one colliery or blast-furnace or factory and wholesale store or warehouse in a dozen can be served by canal in this country. All are served by railways and roads. If our people tried to use canal transport on a big scale, the coal and other commodities, in nineteen cases out of twenty, would have to be transported by rail or road to the canal, probably many miles away, there shipped into barges, and then, after travelling only part of the way by water, would have to be taken out of the barges, put in trucks, and transported by rail to destination. The idea is absurd. The facts speak for themselves. The case of transport of coal from pits in Yorkshire to ports in Yorkshire and Lincolnshire demonstrates beyond dispute that inland water transport is useless except for an extremely small number of our traders.

E. T. GOOD.

Sheffield, July 19th.

BUILT-UP CRANK SHAFTS.

SIR,—I note in your last issue, in your interesting description of the B. and W. oil engine, an illustration of a crank unit. I have pleasure in enclosing you a photograph of a similar type of crank which I introduced about



BUILT-UP CRANK SHAFT

1912, also for vertical, two-stroke, double-acting internal combustion engines. The similarity is very marked. With care in manufacture, these built-up crank shafts were singularly accurate even in those days, and were successful in use. ALAN CHORLTON.

London, S.W. 1, July 19th.

THE DOWSER'S ART.

SIR,—In connection with the letters in your issues of April 22nd and 29th (which have only just reached me), your correspondents seem to miss the main point in water divining, namely, that the water must be running.

Trials over ponds, horse troughs, and the like are, therefore, foredoomed to failure, whereas trials over underground streams, and pipes, in which the water is flowing, are real tests.

It is as idle to deny that certain people possess this gift of water divining as it is to deny that heat comes from the sun. SAPPER.

Quetta, Baluchistan, June 28th.

New Electrical Laboratories at University College, Nottingham.

LABORATORY equipments at colleges where electrical engineering is taught must be kept up to date to meet the requirements of present-day students who have to familiarise themselves with many electrical applications. Until this session the whole of the electrical work at University College, Nottingham, was carried out in the old building in Shakespeare-street, but in future the day work will be done at the new college buildings at University Park, where there are direct-current, high-voltage standardising and photometrical laboratories. Combined with the direct-current laboratory there is one for elementary work, and there is also a separate advanced laboratory which is exceptionally well equipped. Together with the college power-house, workshops, and battery room the new building forms a separate block. In the elementary laboratory students carry out bench experiments which serve as an introduction to electro-technical measurements and the determination of the characteristics of direct-current generators and motors. The advanced laboratory contains motor generator sets of various kinds, different types of A.C. motors and a comprehensive selection of static transformers. The combined sets consist of a steam engine-driven three-phase alternator, two motor alternator sets for three-phase work, and a set consisting of a D.C. motor driving two single-phase alternators, one of which has a stator capable of rotation through 360 electrical degrees. Other sets consist of a three-phase series commutator motor driving a D.C. loading generator with a floating field system, and another consists of a D.C. motor, a three-phase induction motor, and a low-voltage exciter, all coupled together. The separate machines consist of a compensated induction motor, a slip-ring induction motor, four squirrel-cage machines of different types and arranged for different methods of starting, a single-phase commutator motor, and a rotary converter, the outputs of these machines varying from 5 to 20 horse-power. The static transformers are all grouped together and comprise a 60-kVA oil-immersed mining transformer, one 17-kVA and two 5-kVA oil-immersed transformers, and one 5-kVA air-cooled transformer, all for three-phase working. There are also seven single-phase transformers, two of which have tappings for Scott transformation from three to two-phase.

Current can be obtained in the laboratories at 440 volts from a D.C. three-wire supply, a three-phase and single-phase supply from the power-house, and from a three-phase supply from a 60-kVA turbo-alternator set housed in the heat engine laboratory, which is adjacent to the electrical engineering laboratories. Alternating current can also be obtained from the motor generator sets in the advanced laboratory and a two-phase 10-cycle supply can be derived from the slip rings of a three-wire generator in the power-house. When a very steady voltage is required it can be obtained from a large 440-volt battery. There is a turbo-alternator set complete with condenser and all auxiliary plant and its supply of steam can be drawn from two alternative water-tube boilers, one having an automatic stoker and the other arranged for hand firing.

The work on machine characteristics done in these laboratories is supplemented by special tests carried out in the power-house, which provides the whole of the lighting and power for the college buildings and grounds. The 11,000-volt supply is converted to 440 volts D.C. three-wire, the most important machine used for this purpose being a 150-kW rotary converter which has a special armature winding with slip rings so that oscillograph records of the flux distribution and current wave form can be obtained from a tapping point. As the machine is provided with an exciter it can be run inverted for the purpose of experimental work. In order to provide students with experience with an entirely different type of plant a 50-kW mercury arc rectifier has recently been installed and all its circuits are brought out to a link board so that instruments can be inserted for making tests. The standby plant consists of the battery, which can be manually or automatically controlled, and a cold-starting oil engine set with a three-wire generator and static balancer.

The main equipment in the high-tension laboratory consists of a 25-kVA single-phase transformer giving 150,000 volts R.M.S. There are also small transformers giving pressures up to 20,000 volts. Three high-tension terminals are provided by three strings of suspension insulators, the position of all three being adjustable, and when a bus-bar is required a round bar is slung between two of the strings by means of standard cable clamps. For measuring the voltage the sphere gap method is employed, and there are three alternative pairs of spheres of different size. When using any particular pair the top sphere is fixed and the bottom and earthed sphere is adjusted by mechanism outside the high-voltage enclosure. The position of this sphere is determined by a very accurate cathetometer reading to one-hundredth of a millimetre and enabling estimations to be made to one-thousandth of a millimetre. In view of the great importance of the Schering bridge method of testing insulating materials, the necessary equipment for this work is being developed.

The standardising laboratory is equipped with a standard Wheatstone bridge, potentiometers, a Kelvin double bridge for the measurement of very low resistances, apparatus for testing iron and for the measurement of inductance and capacitance by A.C. bridge methods. The photometrical laboratory equipment, which is entirely new, consists of a standard photometer bench with heads of different types and standard lamps for visual photometry. Photometry is also carried out by means of photo-electric cells both over the visible and invisible ranges of the spectrum. In the past a great deal of research work was carried out in the old laboratories, and the facilities for this work have now been considerably improved.

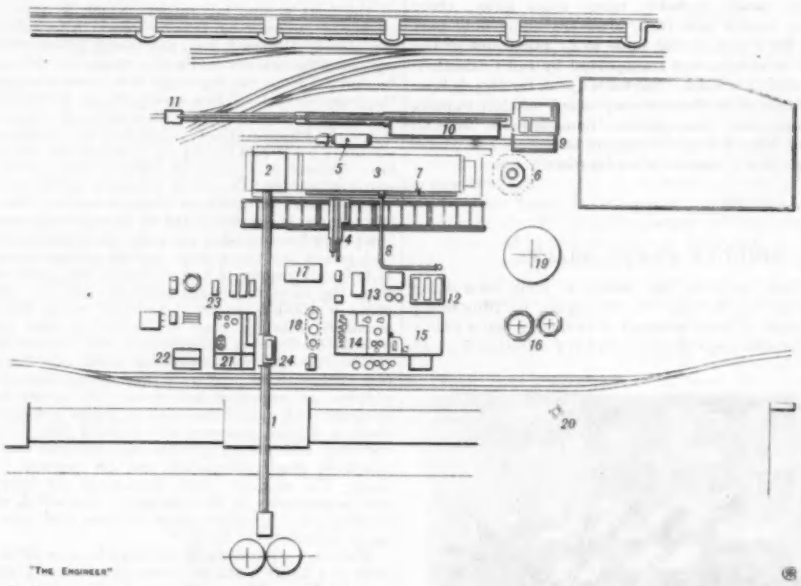
GAS RESEARCH IN CANADA.

DURING the last year the production of waste gas in Alberta, particularly in the Turner Valley, has continued on an ever-increasing scale. The Associate Committee on Gas Research of the National Research Council of Canada has therefore concentrated its efforts almost entirely on the utilisation of this gas. Extensive research has been carried out in the laboratories of the University of Alberta. Viking gas has been used in these experiments. It is almost sulphur-free, but contains a smaller proportion of the higher hydrocarbons than does the gas of the Turner Valley, the methane content being about 93 per cent. as calculated from combustion analysis. In order to find catalysts which might promote the formation of ethyl alcohol from water gas, or from a mixture of carbon dioxide and hydrogen, a series of experiments was carried out on the decomposition of alcohol, on the principle that a catalyst which promotes a given reaction will also promote the reverse reaction. No catalyst has been found which will give a clean decomposition, but some of those tried have produced carbon dioxide and hydrogen almost exclusively. When water gas under a pressure of 2500 lb. was heated in a glass-lined steel reaction chamber in the presence of a catalyst it gave mixtures of acetic acid, methyl alcohol and water, without any carbon deposit. Work was carried out on the heat treatment of natural gas and in particular the relation between the yields of solid and liquid hydrocarbons, the composition of the gas and the temperatures of the reactions. The gas was passed through quartz tubes at different rates in order to vary the time of contact, the temperature used being in the neighbourhood of 1000 deg. Cent. There proved to be an optimum time of contact for the maximum yield of liquid products and another for the formation of acetylene. Ethylene, on the other hand, did not reach a maximum, the yield increasing with rising temperature and decreasing time of contact. The light oils produced in the reactions were collected by means of charcoal. The liquid consisted of 81 to 90 per cent. benzene, about 10 per cent. toluene, and a small naphthalene fraction, the total yield being about 12 per cent. of the theoretical.

Becker Coke Oven and By-Product Plant at Scunthorpe.

No. I.

SCUNTHORPE is in Lincolnshire, a county which is associated by most people with agriculture, but which, as many engineers know, contains hills largely composed of ironstone. The ore has a poor proportion of iron, so much so that some 3 tons of slag must be got rid of for every ton of iron produced. In addition blast-furnaces, three of a nominal capacity of 1000 tons each per week, and two of 1400 tons each per week. These furnaces are all mechanically charged on the Pohlig system, blast being supplied by means of gas-blowing engines utilising clean blast-furnace gas. The plant is comparatively modern in lay-out, and designed to dispense with surplus labour wherever possible. The steel plant consists of four 50-ton open hearth furnaces, one 120-ton tilting furnace, one 50-ton Terni fixed furnace, and one 60-ton fixed furnace. These and a 350-ton mixer, were formerly fired by gas from a battery of Kerpeley gas producers



1. Coal conveyor.
2. Coal storage bin.
3. Coke Oven Battery.
4. Pusher machine.
5. Coke car.
6. Stack.
7. Collecting main.
8. Suction main.
9. Quenching station.
10. Coke wharf.
11. Coke screening station.
12. Primary coolers.
13. Tar extractors.
14. By-product house.
15. Sulphate store.
16. Tar and ammonia storage tanks.
17. Liquor flushing and separating tank.
18. Benzol scrubbers and final cooler.
19. Gas holder.
20. Bleeder.
21. Lime mixing room.
22. Waste liquor settling basin.
23. Crude benzol plant.
24. Acid storage tank.

FIG. 1—LAY-OUT OF GAS-MAKING AND BY-PRODUCT PLANTS

the fuel required must be drawn from considerable distances.

With such adverse circumstances, John Lysaght, Ltd., the iron and steel makers, who have also works in South Wales, have succeeded, at the Normanby Park Works, Scunthorpe, in evolving an arrangement which bids fair to establish a lead in the economic production of steel.

The works which we propose to describe and which are illustrated by the engravings herewith and on page 88, have been in existence for some considerable time, but under the control of Mr. W. J. Brooke, the general manager, and Mr. F. H. B. Gough, the chief engineer, they have been transformed, after two years' work, into one of the most advanced steel-making plants in existence. In this achievement the company has been assisted by the engineers of the Woodall-Duckham Vertical Retort and Oven Construction Company, Ltd., of 136, Victoria-street, Westminster, who provided the new coke ovens at the works.

The aim of the engineers has been to make the coal used in the blast-furnaces provide all the power needed to convert the ore into semi-finished steel—that is to say, into billets, sheet strip, and so forth.

They have completely succeeded in this effort, and have brought the results to such a state of perfection that even with Lincolnshire ore, which involves the heating to fusion temperature of about three times as much rock as the iron recovered, there is now only an expenditure of 27 cwt. of coke per ton of iron produced, and there is every prospect of this consumption being reduced to 25 cwt.

The works have the natural advantage of a compact arrangement, which enables the heat of the molten iron, as it is tapped from the blast-furnace, to be conserved to the utmost until the metal is passed through the rolling mill; but of greater importance is the direct conservation of the fuel itself. That conservation has been largely effected by the use of blast-furnace gas for heating the coke ovens—the first example of their class in this country. Some idea of the care with which this conservation has been carried out may be gathered from the fact that the engineers do not desire a much greater efficiency in the blast-furnaces themselves than that already achieved, an efficiency which is the result of the careful grading and crushing of the ore, as otherwise the blast-furnaces would not produce sufficient gas to carry out the whole cycle of operations.

Solid fuel is used only for the reduction process in the blast-furnaces. All other operations requiring energy are supplied by gas, either from the furnaces or from the coke ovens. The former is of what is generally described as "lean" quality, while the oven gas is "rich." Each has its merits, and the two are used, either individually or in admixture, according to the service required. The plant comprises five fitted with Chapman agitators. The furnaces are of a modern type and are equipped with charging machines and overhead cranes for the handling of materials into and out of the furnaces.

Ingots are heated in four gas-fired soaking pits, supplied with blast-furnace gas, usually enriched with surplus gas from the coke ovens. Further ingot heating capacity is provided by four recuperator pits, which have been converted out of ordinary coal-fired pits to a design introduced and perfected by the works staff. The rolling mills, which are designed for the production of sheet bars and billets, consist of a 36in. cogging and a 32in. finishing mill, each driven by a separate engine and capable of producing up to 4000 tons per week of semi-finished products.

The whole of this plant is now served, so far as concerns its heat requirements, either directly or indirectly, by the new battery of forty-seven Becker coke ovens, which we illustrate. These ovens provide all the coke necessary for the blast-furnaces, and, in addition, yield a large amount of gas. The blast-furnaces also produce gas, and the two gases are kept separate throughout the works, although they are, in some parts, burned in conjunction. Thus, the coke ovens are normally heated by blast-furnace gas, but may use their own gas for that purpose in case of emergency. The boilers are fired with furnace gas, and have the same alternative. The steel furnaces are heated almost entirely by oven gas and the soaking pits with a mixture of the two. The blowing engines are driven by blast-furnace gas. In order to make the system of conservation as complete as possible, the waste heat from the steel furnaces is used to raise steam, to add to the general supply, and the exhaust steam from the mill engines is passed through a turbo-blower. An important feature of the whole installation is a waterless gasholder, of 2 million cubic feet capacity, which is used to regularise the supply of blast-furnace gas throughout the system.

There are occasions when the blast-furnaces may have to be shut down, and for other reasons the supply of furnace gas may fluctuate. Hence, over and above the insurance given by the big gasholder there is an elaborate system of signals throughout the works to ensure that the gas is used to the best advantage. These signals, one of which we illustrate, show pictorially the condition of supplies in both systems and give audible warning when either is approaching the danger limit. It is then possible to adjust the consumption of either one or both of the gases until the trouble has been overcome.

At the steel furnaces a combination arrangement has been installed which enables the calorific value of the mixed gas to be kept constant by operating one valve only. If, at any time, by reason of furnace conditions, it is necessary to alter this mixture, it can be easily done by a clutch attachment which has been fitted to the coke oven gas valve. Gauges for indicating the gas and air pressures at the incoming end, and gas and air suction at the outgoing end, are also used on each furnace. These gauges are also recording instruments. The air chequer temperatures are recorded and waste gas temperature indicators are also used. The furnaces are fitted with fans for giving a positive air supply into the furnaces, and so arranged that the quantity of air being used can be measured at any time. By the installation of these instruments all the essential information with reference to combustion is readily available, and the men have now been trained to work the furnaces by the indications of these instruments.

In carrying out this departure from usual practice, it was decided to make little or no alteration in the design of the steel furnaces in order that, should occasion arise, the furnaces could be again heated with producer gas if required. It was, therefore, necessary to mix the two gases in such proportion as to give the corresponding heat value of the producer gas thus displaced. In practice it is found that this proportion works out at approximately 100 parts of blast-furnace gas to 40 of coke oven gas, both by volume. This proportion can be varied by the furnacemen if necessary, and experience has shown that adjustments of this character can be very advantageously made use of to assist in accelerating the furnace reaction. It has already been found of very great value to be able to control and assess at any time the actual quantity of gas passing into the

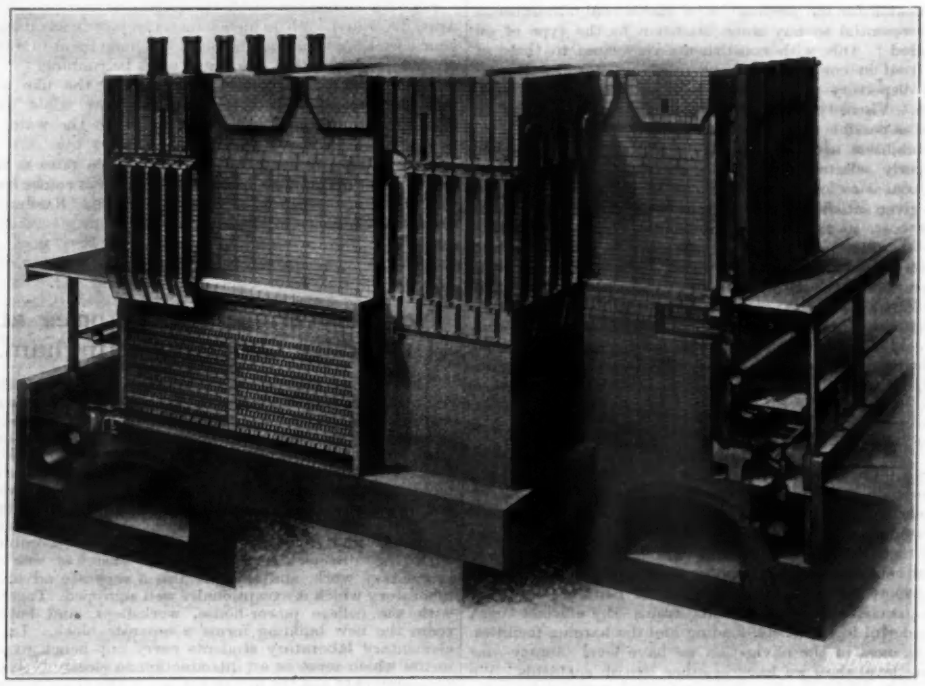


FIG. 2—SECTIONAL VIEW OF BECKER COKE OVEN

furnace, and considerable economies in fuel have, as a result, been made possible.

It is interesting to note the relative requirements, in the way of heat, of the various departments of the works. Expressed as percentages they are :

Coke ovens	14·5
Stoves	11·2
Boilers	27·2
Soaking pits	9·8
Power-house	7·5
Steel plant	29·8
	100·0

The installation of coke ovens, illustrated in Figs. 7 and 9, page 88, consists of a battery of forty-seven Becker regenerative combination ovens. Each oven is 40ft. 8in. long between the doors and 12ft. 6in. high, and has an average width of 16in. It has a capacity of about 624 cubic feet and carbonises approximately 14·1 tons of wet coal containing 10 per cent. of water in 15½ hours, or 21·8 tons in twenty-four hours. Under these conditions the whole battery is therefore easily capable of carbonising 1020 tons of coal and producing therefrom over 670 tons of furnace coke per twenty-four hours. The battery has been so arranged that it may be extended to double its length in the future, if necessary.

The ovens are so designed that they can be heated either with coal gas or blast-furnace gas. After being first started up on coal gas they were changed over to blast-furnace gas and have since been operating with that gas as the heating medium. The reversing valves controlling the supply of heating gas are so arranged that any chosen number of ovens can be heated by blast-furnace gas whilst the remainder are heated by coke oven gas. The operation of changing over from one type of gas to the other is simple and easily effected. The blast-furnace gas is delivered to the plant with a dust content of less than 0·003 grain per cubic foot, being cleaned in a set of Theissen rotary washers. In order to safeguard the battery in the event of failure of the blast-furnace gas supply, electrical control gear is provided, which is such that when the gas pressure fails the reversing machine is automatically put into a neutral position and a Klaxon horn blows a warning.

The oven brickwork from the pad upwards is constructed entirely of silica, excepting only the filling in the regenerators and the end walls adjacent to the pinion walls. The oven jambs, regenerator facings, and oven tops are insulated, the latter having a finish of paving bricks. The pinion walls at each end of the battery are constructed in concrete and provided with substantial wing walls. Fire-brick-lined concrete waste gas flues are built along each side of the battery and connect into a single flue leading to the oven stack placed at one end of the battery. The stack is 250ft. high and is fire-brick lined for the first 50ft. Two hand-operated dampers and an automatically operated stack damper are provided for regulating the draught.

The coal for the ovens is stored in a reinforced concrete bin having a capacity of 1200 tons of washed crushed coal. It is built in three bays, with four hoppers in each bay. Each of the twelve hoppers has a discharge gate, hand operated from a platform beneath the bin. An electrically propelled coal charging car, with a total capacity of approximately 14½ tons of coal, runs on rails along the top of the battery and is of the Wellman type, which we have already described. The car has four steel hoppers, each fitted with an electrically operated mechanical stirring equipment and an adjustable measuring device. The cast iron drop sleeves for directing the coal into the ovens are operated by a lever interlocked with the traction motor, which makes it impossible to move the car with the sleeves down. A scale of approximately 50 tons capacity is provided for weighing the coal in the car before charging and is provided with ticket printing equipment for recording weights. A hoist, electrically operated, is provided for retrieving coal withdrawn in the levelling operations and returning it to the coal charging car. This coal drops into a hopper attached to the pushing machine and is occasionally dropped into a skip which is hoisted to the upper level.

The heating system of the Becker oven may be described as follows :—There is a series of vertical flues on each side of each oven and two regenerators are built under each series of vertical flues (Fig. 2). When blast-furnace gas is being used as the heating medium air travels up one of the two regenerators and gas up the other. Both the air and the gas enter the bottom of their respective regenerators from both ends of the oven at the same time. After passing through in an upward direction and absorbing heat from the chequer filling in transit the air and gas leave the top of the regenerator and enter the bottom of the vertical flues through ports so designed in relation to each other that the air and gas come together with streamline effect and the combustion zone is evenly distributed throughout the length and height of the vertical flues. The products of combustion are then collected from the top of each of four or five vertical flues and are carried over the top of the oven by means of cross-over flues. There are six cross-over flues to each alternate oven, the intermediate ovens not requiring any, as will be seen from the illustration. From these flues the waste gases are distributed into an equivalent number of vertical flues on the other side of the oven exactly opposite the flues up which they have travelled. They then travel down these flues and into the two regenerators immediately below, through which they pass to the waste gas flues, giving up heat to the chequer filling in transit.

FIG. 3—WARNING DEVICE

Upon reversal, which is automatically controlled, the air and gas travel up through the regenerators and vertical flues down which waste gas has previously passed ; the products of combustion travel through the cross-over flues and down the flues and regenerators on the opposite side of the oven up which air and gas have previously travelled. This arrangement of heating ensures that the travel of gases throughout the system is short and unidirectional, and consequently there is a low difference of pressure between opposite sides of the brickwork and a minimum of leakage. The velocity of the gases is slow and uniform, so that good regulation can be easily obtained. At all times and under all conditions the gas and air and combustion gases flow in parallel in an upward and vertical direction through the whole length of the regenerator and the oven flues on one side, and the waste gases flow in a similar manner in a downward direction but on the opposite side of the oven. By this arrangement of flues walls without expansion joints can be employed for separating the gas and air and waste gas. By means of the cross-over flue a very strong form of construction is obtained, inasmuch as all horizontal flues or conduits are reduced to a minimum in number and in cross sectional area.

The regenerators are so arranged that those in which gas is being heated are never adjacent to those in which waste gas is flowing. In actual fact two adjacent regenerators carry gas and are flanked on either side by a regenerator carrying air for combustion, so that each adjacent set of four regenerators carrying the fuel gas and air for combustion are under the same suction conditions. Conversely, the four adjacent regenerators on each side carry the waste gases, and thus the only walls on the sides of which countercurrent flow occurs are those between regenerators carrying air and waste gas, namely, every fourth wall, and any danger of short-circuiting is eliminated.

When coke oven gas is used as the heating medium air enters and travels up all the regenerators and the coke oven gas is delivered through a horizontal gas conduit carried in the brickwork between the top of the regenerators and the bottom of the vertical flues. From these conduits the gas passes by means of a calibrated nozzle and vertical duct into the bottom of each vertical flue, where it mixes with the preheated air coming from the regnerators. The flow of the gases from this point onwards is the same as when blast-furnace gas is used. The air and blast-furnace gas reversing valves—see Fig. 6—or coal gas valves are automatically operated at the required intervals by a single machine, which is connected to the individual reversing valves by suitable mechanism.

The reversing machine (Fig. 5) is placed in a control room at the end of the battery. The machine is normally operated by an electric motor, and a steam-operated standby is provided which can be used in case of power failure. It is very similar to that which we described in connection with the Thorncliffe works. The movements of the machine are controlled by an electric clock which can be set to operate the reversing mechanism at various time intervals. Should for any reason the clock fail to operate the mechanism at the predetermined time, within five minutes a water safety device causes the steam siren to blow. Orifice type meters are provided for indicating, integrating, and recording the quantity of blast-furnace gas or coke oven gas supplied to heat the ovens.

When carbonisation of the coal charge is complete the coke is pushed out of the oven by means of a pusher machine into a coke quenching car, both of which are by the Wellman Company and are familiar to our readers. The machine is well illustrated in Fig. 9. An innovation has, however, been introduced in the form of two electrically operated clay carriers which carry luting clay from a clay mixer situated under the coal bin to the ovens and elevate the clay at the oven doors. One of these carriers runs on overhead rails on the pusher side of the battery and serves the doors on that side, and the other runs on

FIG. 4—GAS INDICATING APPARATUS IN STEEL WORKS

FIG. 5—COKE OVEN FLUE DRAUGHT REVERSING GEAR

the door machine and coke guide track on the coke side. To ensure efficient luting of the doors and to facilitate operation each machine is fitted with an electrically operated elevator provided with travel limit switches and safety device, on which the man attending to the luting rides. Two spare rams, one for the pusher and the other for the leveller, are kept at the end of the battery and can be quickly put in place in the event of damage to the working rams.

The coke quenching car, with its load of hot coke, is run by an electric locomotive into a central quenching station of the re-circulating type placed at the end of the battery, where it is sprayed with a predetermined quantity of water. From a 10,000-gallon overhead quenching tank water is delivered to the quenching sprays through a 16in. diameter pipe line fitted with a hydraulically operated quick-opening valve controlled automatically by the electric locomotive as it enters the station. Two electrically operated quenching water pumps are provided for delivering water from the hot well to the quenching tank. Each pump has a capacity of 25,000 gallons of water per hour, and one acts as a standby to the other. They are automatically controlled from a float in the overhead quenching tank. A breeze-settling sump is provided alongside the quenching tower.

(To be continued.)

FIG. 6—GAS REVERSING VALVES ON OVEN FRONTS

The Society of Chemical Industry.

ANNUAL MEETING AT NOTTINGHAM.

HAVING regard to the multiplicity of industries in the Nottingham district and to the fact that chemistry forms the basis of all industry, the choice of that city for the fifty-first annual meeting of the Society of Chemical Industry was very appropriate. The meeting, which was held there last week under the presidency of Professor G. T. Morgan, D.Sc., F.R.S., was most successful from the points of view of entertainment and instruction.

The members and their ladies were received on Tuesday evening, July 12th, in the Great Hall of University College in University Park, Nottingham, by the Right Hon. Lord Trent (Chairman of the Nottingham Section of the Society) and Lady Trent. The College itself, which was opened in July, 1928, by their Majesties the King and Queen, forms a fitting and enduring memorial to the late Lord Trent (formerly Sir Jesse Boot). Through the activities of the East Midland Educational Union and the Department of Adult Education, the College has already effected a kind of educational federation with towns as far apart as Northampton, Lincoln, Mansfield, and Newark. This co-operation extends to the highest branches of education, since the College has gained greatly by the recruitment of well-trained and able students from these and other towns. It has been assisted also by way of grants, and in many other ways by the counties and county boroughs of the whole East Midland area, and has endeavoured to return these benefits by meeting all demands for general and specialised instruction.

Before the first business session, on Wednesday morning, July 13th, the members were accorded a civic welcome by the Lord Mayor of Nottingham (Alderman W. Green).

The annual report of the Council of the Society for the year 1931–32 showed a loss of membership, but it was much less than the Council anticipated at the beginning of the year, and is claimed to be proportionately a much lighter loss than most scientific societies have suffered in the same period. At July 13th, 1932, the membership numbered 4410, as compared with 4541 in July, 1931. The number of new members elected, however, exceeded that of recent years. The new President of the Society for the year 1932–33 is Dr. Robert H. Pickard, F.I.C., F.R.S. (Director of the Shirley Institute of the Cotton Research Association). During the coming session the Society's Jubilee Memorial Lectures—the jubilee was celebrated last year—are to be delivered at various centres. The lecturers for the session will be Dr. E. F. Armstrong, who will lecture on "Alcohol Through the Ages," at Birmingham, Leeds, and Bristol; and Dr. G. D. Bengough, who will lecture on "The Corrosion of Metals in Salt Solutions and Sea Water," at London, Glasgow, Manchester, and Newcastle. Last year the Council accepted the sum of £1500 from Mr. John Gray, a former President, for the purpose of founding an annual scholarship tenable for a year at an approved seat of learning for post-graduates about to enter industry, preference to be given to a son of a member of ten years' standing. The first scholar was Mr. G. Alan Thompson, who is completing a year of research under Professor J. W. Cobb in the University of Leeds.

PRESIDENTIAL ADDRESS.

The presidential address by Professor Morgan was a plea for the unification of chemical societies. It had been stated, the President said, that there were upwards of sixteen separate societies which had for their object the furtherance of the professional and scientific welfare of chemists. He had made a survey of about fourteen of them, nearly all of which were concerned mainly with the publication and distribution of scientific literature. Owing to the continual increase in the output of chemical communications that task was becoming increasingly expensive, and in the case of the two societies which bore the main burden of publications economic stress had brought about a rapprochement, so that the Chemical Society and the Society of Chemical Industry had come to an agreement with regard to the production of chemical abstracts. The President made an examination of the resources of the fourteen bodies mentioned, and urged that if they could work together and pool financial resources they would assume a splendid position among the learned professions, based on a federation of scientific activities, a collaboration in technical publication, and a community of professional interests.

His statistical survey, although only approximately accurate in arithmetical details, served to indicate two general tendencies; first, that a considerable proportion of members' subscriptions went in administrative and office expenses; and secondly, that the task of supplying to British chemists a complete epitome of chemical progress in the form of "Transactions" and "Abstracts" was becoming an intolerable financial burden to those societies which undertook the major part of that vital function. If any economy could be effected on administration, some of the saving should go to the relief of publication expenses, while the remainder might be used to effect a general lowering of the rates of subscriptions. Moreover, reunion of certain chemical associations might eliminate some subscriptions altogether. Assuming four or five thousand chemists regarded some change as desirable, the next step would be to start an inquiry in all the main chemical associations in order to ascertain how far each society could reorganise itself to the public good of all the other chemical bodies. In any changes which might ensue it was most desirable that the individuality and goodwill of each society should be perpetuated to the utmost extent compatible with a general scheme of reunion. The two bodies concerned on the professional side of chemistry should aim at closer co-operation. On the scientific side the Society of Chemical Industry and the Chemical Society, the parent institution, should collaborate even more intimately along lines already traced by the Bureau of Chemical Abstracts. From such affiliations of four general bodies a central organisation might arise having a membership of seven or eight thousand, which would serve as a nucleus of consolidation for the more specialised societies.

Of the fourteen selected societies mentioned, six encouraged research in various branches of chemistry either by grants or by scholarships. A united body might link up these beneficent activities with facilities for chemical investigation in universities, technical colleges, research associations, and other appropriate centres. Many of the natural products of the Dominions and Dependencies were in need of intensive chemical investigation. To carry out such researches in a thoroughly effective and comprehensive manner needed the expert organisation which could be best supplied by a central body fully representative of British chemistry.

THE MESSEL MEDAL.

The main proceedings on Thursday, July 14th, were the presentation of the Messel Medal to Sir William Pope, K.B.E., F.R.S., and a lecture by him on "Forty Years of Stereo-chemistry." Sir William is Professor of Chemistry at Cambridge University.

The programme of the meeting included an inspection of University College, and a number of visits to various works in the Nottingham district, including those of the Staveley Coal and Iron Company, Ltd., the Raleigh Cycle Company, Ltd., Rolls-Royce, Ltd., the Barnstone Cement Company, Ltd., Manlove, Alliott and Co., Ltd., and the Stanton Ironworks Company.

The World's Shipping.

ACCORDING to figures published in the 1932–33 edition of Lloyd's Register Book, the number and tonnage of existing vessels in the world, including about 520,000 tons of new ships afloat and in course of classification, is 15,494 of 43,347,008 tons. During the last twelve months there has been a decrease in the steam tonnage owned in the world of 961,604 tons, an increase of 606,944 tons in the motor tonnage, and a decrease in the tonnage of sailing vessels and barges of 42,070 tons, making a net decrease of 396,730 tons, in the total world tonnage. The countries showing the largest increases for the last twelve months are:—

	Tons.
Norway	101,333
Danzig	82,355
Soviet Russia	81,308
Greece	72,282
Italy	54,899

The largest decreases amongst the principal maritime nations are:—

	Tons.
Great Britain and Ireland	631,230
Holland	154,330
U.S.A.	95,563
Germany	89,759

During the nine years 1914–23 the net increase in the world's steam and motor tonnage was 16,931,000 tons, equal to 37·3 per cent. of such tonnage in existence in 1914, whilst the net addition during the nine years 1923–32 amounted to only 6,033,000 tons, equal to 9·7 per cent. of the tonnage at 1923. These figures represent an average yearly increase of only just over 1 per cent. for the last nine years. During the period 1923–32 the largest increases were:—

	Tons.
Norway	1,788,000
Germany	1,633,000
Greece	723,000
Japan	651,000
Sweden	555,000
Italy	450,000

On the other hand, the sea-going tonnage of the U.S.A. decreased by 3,156,000 tons.

The increase of tonnage belonging to Great Britain and Ireland (670,000 tons) during the last eighteen years represents only 3·5 per cent. of the tonnage owned in 1914, whereas the aggregate increase of tonnage owned in other countries represents more than 84 per cent. of the pre-war tonnage owned abroad.

The total percentage of sailing vessels and barges to the world's total tonnage hardly reaches 2; 53·2 per cent. of the total number is owned by the U.S.A., although Great Britain still has the appreciable amount of 110,000 tons. There are still in existence twelve sailing vessels of between 3000 and 3400 tons gross.

The size group of vessels with the largest aggregate of tonnage is that lying between 4000 and 6000 tons, amounting to 19,168,619 tons, equal to 28 per cent. of the world's total steam and motor tonnage. The big liners, i.e., those of 15,000 tons each and upwards, represent only 5·27 per cent. of the total tonnage. It may be noted, however, that nearly 50 per cent. of such liner tonnage is owned in Great Britain and Ireland.

Within the last twelve months there has been an increase of 606,944 tons in the tonnage of motor ships, and of 366,000 tons in the tonnage of vessels fitted with steam turbines. The tonnage of steamers fitted solely with reciprocating steam engines has actually decreased by 1,326,000 tons.

At the present time less than 55 per cent. of the tonnage of the world's merchant marine depends entirely upon coal, while in 1914 the percentage was nearly 89. During the last eighteen years there has been a reduction in the tonnage of vessels using coal of more than 5½ million tons. Detailed figures are as follows:—

	1914. Per cent. of total gross tonnage.	1932. Per cent. of total gross tonnage.
Sailing vessels and sea-going barges	8·6	1·96
Oil for internal combustion engines	0·45	14·40
Oil fuel for boilers	2·65	28·87
Coal	88·84	54·77
	100·00	100·00

Without taking into account size, age, or material, there are about 11,280,000 tons of vessels—for example, trawlers, tugs, cable ships, and dredgers—which are not used for ordinary cargo and passenger purposes. The merchant fleet of Great Britain and Ireland has, relatively to other countries, the highest efficiency by owning 28·6 per cent. of the world tonnage, as recorded in Lloyd's Register Book, whilst actually possessing 38·49 per cent. of the more efficient ocean-going tonnage available for general cargo and passenger purposes.

The aggregate steam and motor tonnage broken up during the nine years 1923–31 (7,537,000 tons) represents a yearly average of 1·3 per cent. of the tonnage owned. Adding to these figures the tonnage of steamers and motor ships lost through casualties during the same period (3,839,000 tons), it will be seen that the average wastage of sea-going merchant tonnage (excluding sailing vessels) does not reach 2 per cent. per year of the tonnage owned.

Railway and Road Matters.

WORK is nearing completion on a village of 120 houses built to accommodate staff employed at the L.M.S. Railway's new locomotive depot at Royston, near Cudworth, Yorkshire, and all the houses are now occupied by tenants.

IT is announced by the Institute of Transport that the next examinations for graduateship and associate membership will be held on April 27th, 28th, and 29th, 1933, in London and at a number of provincial and overseas centres.

THE Ministry of Transport has arranged for a special investigation of the causes of all fatal road accidents over a period sufficiently long to give reliable results and to publish the results in the form of a return which for some time has been in preparation.

IT was one hundred years, on Sunday last, the 17th, since the opening of the Leicester and Swannington Railway. It connected the Leicestershire coalfields with the canal at West-bridge, Leicester, and was the second section of the Midland Railway to be sanctioned and the first to be opened.

IT is reported that the "Tyneside Venturer," the Armstrong-Whitworth oil-electric motor train, which completed on Tuesday, July 5th, three months' continuous service on the London and North-Eastern Railway system at Newcastle, has covered an average of 1045 miles per week, with an average consumption of less than 200 gallons of Diesel oil. Total fuel and lubricating costs have not exceeded ¾d. per mile.

THE prospects of the London Passenger Transport Bill have greatly improved. According to a statement issued by the Minister of Transport on July 15th, the body which is to appoint the members of the London Passenger Transport Board is to consist of the chairman of the Bankers' Clearing House, the president of the Institute of Chartered Accountants, the president of the Law Society, the chairman of the London County Council, and a representative of the London and Home Counties Traffic Advisory Committee. Further, the Minister proposes to transfer to the Railway Rates Tribunal the power to order new or improved services and facilities and other analogous powers, which, it had been objected, conferred excessive authority upon the Minister. The Metropolitan Railway Company, on July 14th, formally agreed to join in the scheme.

THE collision between two empty passenger trains at Victoria Station, Manchester, L.M.S.R., on April 11th, mentioned herein on April 22nd, and in which a guard was killed, was inquired into by Lieut.-Colonel Anderson. That officer's report thereon was issued on July 8th, and places the cause for the accident on an error of judgment by the signalman in Victoria East Junction signal-box. The signalman concluded that the tail of the first train was clear of the crossing over which the second train was allowed to approach. It was, however, fouled by some 15ft. or 20ft. It was dark at the time and the point of collision was 35 yards away. There is a track circuit on the line in question, but it is for the home signals for that line, and ceases 94 yards past the signal and 31 yards short of the crossing. Clearance bars or an extension of the track circuit are recommended.

THE intimation in our North of England's correspondent's letter, which appeared in our issue of July 1st, that the London and North-Eastern Railway Company's works at Gateshead are to be closed, reminds us of the good work done in the production of munitions in these and other railway-owned shops. At Gateshead and Eastleigh improvements were made on the methods of firms engaged in ordnance manufacture. At Gateshead, for instance, as we related in the article of our series "British Railway Workshops in War-time," which appeared on page 577 of THE ENGINEER of June 13th, 1919, 250 6in. Newton trench mortar howitzer barrels were machined. The lips of the barrels, which were shrunk on to the lugs, continually came off, and the guns had to be returned to England. On the suggestion of Mr. H. G. Bell, the works manager at Gateshead, the lug and lip were made part of the gun and formed from the solid.

THE annual review of the standard charges of the four grouped companies by the Railway Rates Tribunal was mentioned herein on May 13th. The Tribunal's judgment, delivered on July 15th, was that no modification could be made to increase the standard revenue. It was remarked that the question of efficiency and economy in the management was looked into even more closely than on previous reviews. The Tribunal heard very detailed evidence which satisfied it that to meet the position caused by the deepening of the trade depression and intensification of road competition the railway companies had used their best endeavours to protect their revenues and offset their losses by economies, while at the same time they had not diminished, but in many cases had increased, the services and facilities which they rendered to the public. The Tribunal was satisfied of the companies' determination to continue their efforts, and it found that the deficiencies were not due to lack of efficiency or economy in the management.

ACCORDING to the Board of Trade returns, the value of the railway material exported during the first five months of the present year was as follows, the corresponding figures for 1931 and 1930 are added in brackets:—Locomotives £181,044 (£870,058, £1,517,356); rails, £182,132 (£488,852, £1,038,284); carriages, £152,635 (£733,510, £731,894); wagons, £180,008 (£618,031, £1,400,309); wheels and axles, £82,442 (£145,612, £316,037); tires and axles, £82,442 (£145,612, £316,037); chairs and metal sleepers, £75,034 (£149,415, £349,240); miscellaneous permanent way, £86,395 (£216,409, £382,903); total permanent way, £503,827 (£1,124,011, £2,287,858). The weight of the rails exported was 20,671 tons (58,374 tons, 118,003 tons), and of the chairs and metal sleepers, 8486 tons (20,340 tons, 37,610 tons). During the month of May last the value of the locomotives shipped overseas was £23,474; the rails were of the value of £68,770, and included: South Africa, £22,038, and Portuguese East Africa, £2356.

Notes and Memoranda.

THE world's trade in timber is approximately 80 per cent. in softwoods, 18 per cent. in temperate hardwoods, and 2 per cent. in tropical hardwoods.

AN oxidised chromium surface has, says the *Iron Age*, withstood momentarily surface temperatures of over 3000 deg. Fah., which is higher than the melting point of chromium.

IT is announced that factory-built houses made of steel are being produced in America which can be erected in one day. The basis of the idea is a steel-framed unit of 16ft. square floor space.

IT is reported that during the process of dredging Port Elizabeth harbour, South Africa, for the purpose of giving a greater depth of water for visiting vessels, no less than thirteen ancient anchors have been brought up by the dredger.

THE probable commercial value for the beryllium-iron alloys is indicated by recent researches by Kroll, mentioned in the *Iron Age*. Alloys of iron, chromium, nickel, and beryllium show chemical resistivity corresponding to the rustless steels (18 per cent. Cr, 8 per cent. Ni) with excellent hardness, strength, and elasticity.

IN the Reference Library at Canada House, London, S.W. 1, there is a very comprehensive set of geological maps, issued by the Dominion Department of Mines, indexed according to locality, thus enabling callers to study the geology of areas in which mining operations are in progress, or where development is in contemplation.

MINE tracks laid in 1840—the remains of one of the oldest underground railway systems in the United States—were recently found in the Thomaston section of Pine Knot Colliery. In spite of ninety years of exposure to the ravages of time and to the severe action of the mine's sulphur water, the puddled iron rails of the old tracks were in excellent condition.

AS a result of recent developments in the forging of Monel metal rods, shafts, spindles, &c., in large diameters, it has been possible to increase further the range of physical properties of such material, so that a uniform yield point in excess of 70,000 lb. (31·25 tons) per square inch, with an ultimate tensile strength over 90,000 lb. (40·18 tons) per square inch on forged bars from 3in. to 6in. diameter, is obtained. The elongation value averages higher than 25 per cent.

THE United States Bureau of Mines has issued a bulletin on Tests of Rockdust Barriers in the Experimental Mine. It is numbered 353, and is issued at the price of 10 cents. The bulletin describes tests based on the ideas of Monsieur J. Faffanel, former director of the French Government testing station at Lievin, which embody the general principle that should, for some reason or other the general dusting of a coal mine be neglected, the risk of explosion may be minimised by the provision of occasional "barriers" of dust-distributing gear.

A SURVEY conducted by the Dominion Department of Mines at Ottawa showed that deposits of diatomite occur in at least 150 localities throughout Canada, principally in British Columbia, Ontario, and Nova Scotia. The value of the substance as a heat and sound insulator, filter medium, and as an admixture in concrete, has been known for some time. More recently its value as a constituent of asphalt battery boxes and hard rubber products has been recognised. Diatomite is being used to advantage to conserve both heat and "cold," but it is especially well adapted for use as a high temperature insulator in industrial plants.

AIR cooling in the place of water cooling has been adopted in some blast-furnaces at Liége. For cooling a blast-furnace of a daily output of 300 tons, it is found sufficient to produce a blast of 40,000 cubic metres per hour, involving the consumption of 35 kilowatt-hours. The cooling draught is supplied at a pressure of 24 cm. to 30 cm. w.g. in a jacket surrounding the stack, from which it passes by short junction pieces into vertical tubes spaced a certain distance apart, from which, in turn, numerous parallel branches distribute the air into openings in the brickwork of the stack, the depth of openings depending on the thickness of the brickwork.

A METHOD of determining the iron oxide content of liquid steel has been described by the United States Bureau of Mines. The method consists of adding aluminium to steel in a test spoon, pouring the killed steel into a mould, and analysing the metal for Al_2O_3, from which the FeO in the steel may be calculated. When the metal has been deoxidised with manganese or silicon, the silica is reduced to about 0·006 per cent., and it would therefore be expected that almost all of the MnO would be reduced. The true FeO content is therefore not determined. If the electrolytic method is used, in conjunction with the aluminium method, it is possible to correct for SiO_2 and MnO. It is important to remove all the slag from the surface of the steel in the test spoon. A reduction of manganese and phosphorus may take place from the slag on the metal if it has not been completely removed. There is no reduction of manganese or phosphorus from the slag which is used to coat the spoon.

ACCORDING to the *South African Engineer*, Messrs. W. Holms and Patrick Murray, two sugar engineers of Natal, have succeeded in developing the first portable sisal decorticator in South Africa, if not in the world, the machine having been constructed by James Brown, Ltd., and exhaustive tests having provided satisfactory results. The portability of the invention obviously eliminates the need for transporting the sisal leaves to a central plant and removing the waste pulp after treatment. No water is necessary, the fibre coming out straight and clean with a minimum of waste. About 1200 leaves can be dealt with per hour. A Crossley airless injection, two-stroke, oil engine drives the beaters by means of a belt, all working parts being totally enclosed. The beaters are of steel, with brass scrapers bolted on. The moving platform is made of an alloy containing a large proportion of brass to avoid corrosion from the acid in the sisal. Control is practically automatic, the only attention needed being for the feeding of the leaves into the clamps.

Miscellanea.

BRIGHTON Corporation electricity undertaking made a record trading profit last year of £187,000.

EIGHT lives were lost near Maquassi, Transvaal, when 312 tons of dynamite exploded on July 17th, while being conveyed by railway.

THE Institution of Electrical Engineers has decided to convert the whole of its holdings of 5 per cent. War Loan into the new 3½ per cent. War Loan.

OF 2,345,900 motor cycles registered in Europe at the end of 1931, 760,380 were in Germany and 640,152 in Britain, France occupying third place with 469,100.

THE Canadian Pacific liner "Duchess of Bedford" called at Glasgow on July 15th, and departed again 80 min. later, after having disembarked 600 passengers and 700 bags of mails.

THE new electric generating power plant to be put in at Klerksdorp, South Africa, will comprise two Belliss and Morcom triple-expansion sets of 250 kW each, working with steam at a pressure of 200 lb. per square inch and 530 deg. Fah.

WORK has been started on the construction of the new railway and road traffic bridge across the Buffalo River, South Africa. This bridge, which it is expected will require two years to complete, is to have a double deck, and will cost about £150,000.

IT is claimed that about 81 per cent. of the plan for pig iron production during the first six months of this, the final year, of the Soviet Five-year Plan has been fulfilled. While the plan called for 3,656,000 tons, the actual production was 2,984,000.

A NEW canning factory will start operations at Murmansk this year, states the American-Russian Chamber of Commerce. This factory is an auxiliary enterprise of the Northern Fishing Trust, and it will have a production capacity of 300,000,000 cans a year.

REPORTS affirm that the bridge at Attock, between Rawalpindi and Peshawar, in India, mentioned in connection with the bursting of the Shyok ice barrier in our Seven-day Journal of last week, has not been damaged by the passing of the resultant flood.

THE London Chamber of Commerce is pressing for a reconsideration of its proposals, made over a year and a half ago to the Post Office, for the extension of air mail facilities. A reduction in the minimum unit of weight for letters and a general speeding up of services were advocated.

THE two main shaft headgears (the North and South Verticals) at the Randfontein gold mine, are being pulled down and replaced by the most modern steel structures. The work of erection and dismantling is being carried out simultaneously, and as a new steel girder is placed into position so the old wooden counterpart is withdrawn.

THE approaches to the train ferry landings which are to be constructed at Pukow and Nanking, on opposite sides of the Yangtze River, China, to permit direct communication between the North and Shanghai, are to be made by Dorman, Long and Co. The approach spans will be supported on screws, so that the rise and fall of the river, which amounts to some 30ft., can be accommodated. The contract price for the work is said to be £72,000.

A REVISED estimate of the cost of increasing the supply of water from the Vaal River from 10,000,000 to 15,000,000 gallons a day has been prepared by the Rand Water Board. The new figure is £174,000, a saving of £6600 on the original estimate prepared before the work was begun. Good progress is being made with the work, which, among other items, entails the laying of a 31in. diameter pipe line for more than 13 miles, from Vereeniging pumping station to Zwartkopjes pumping station.

ON Tuesday, July 19th, Palmers Shipbuilding and Iron Company, Ltd., launched from the Jarrow shipyard the destroyer "Duchess," which the firm is constructing for H.M. Navy under the 1930 programme. The vessel has a length of 317ft. 9in., a breadth of 33ft., and on her standard displacement of 1375 tons will have a mean draught of 8ft. 6in. Her propelling machinery, constructed at the builders' engine works at Jarrow, will have an estimated output on full-power trial of 36,000, at which power the vessel will attain a speed of about 35¼ knots when loaded to her standard displacement. The armament includes four 4·7in. guns and one 3in. anti-aircraft gun.

THE National Federation of Iron and Steel Manufacturers reports that 311,400 tons of pig iron were produced in June, as compared with 315,300 tons in May, 323,800 tons in June, 1931, and a monthly average of 855,000 tons in 1913. The June production of pig iron included 75,700 tons of hematite, 130,100 tons of basic, 85,500 tons of foundry, and 13,200 tons of forge pig iron. Furnaces in blast at the end of June numbered sixty-nine, the same number as at the beginning of the month. The June production of steel ingots and castings amounted to 459,300 tons, as against 416,900 tons in May, 428,900 tons in June, 1931, and a monthly average of 638,600 tons in 1913.

A SCHEME has been submitted to the Madras Government, according to which it is proposed to install separate oil engine plants in Virudhunagar, Dindigul, and Palni for the supply of electric power to these centres and their neighbourhood. This scheme, which is proposed to be undertaken under the auspices of the Government, promises, says *Indian Engineering*, to be a good commercial enterprise, inasmuch as there is much demand for power in these centres. This scheme will serve as a preliminary to the development of the Periyar hydro-electric scheme. The oil engine sets will be scrapped after the development of the Periyar scheme. While investigations are being conducted to supply electric power from Pykara to Calicut and Cochin on the West Coast, it is also proposed to supply power from the same source to Trichinopoly in the course of next year. As the Pykara power will soon be supplied to Erode and Salem, the transmission line could be extended from Erode to Trichinopoly, where there is expected to be a good demand for power.

COKE OVEN PLANT AT THE NORMANBY PARK STEEL WORKS, SCUNTHORPE

THE WOODALL-DUCKHAM VERTICAL RETORT AND OVEN CONSTRUCTION COMPANY, LTD., WESTMINSTER, ENGINEERS

(*For description see page 84*)

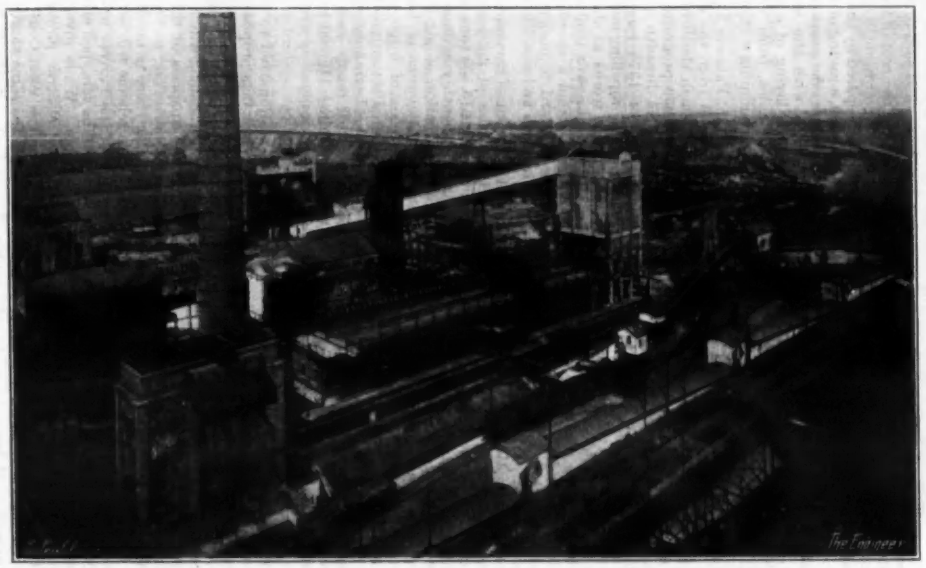


FIG. 7—GENERAL VIEW OF COKE OVEN AND BY-PRODUCT WORKS

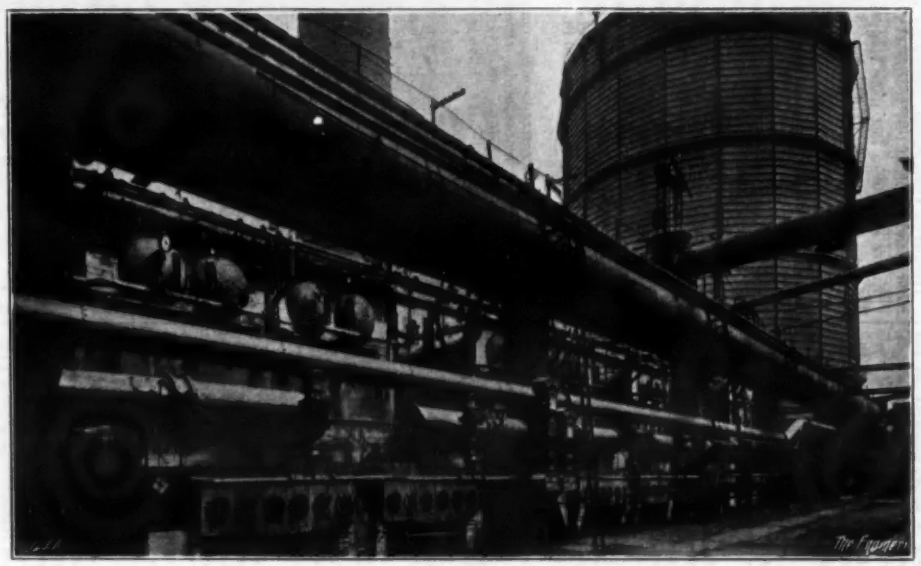


FIG. 8—BOILER FRONTS SHOWING GAS INDICATORS

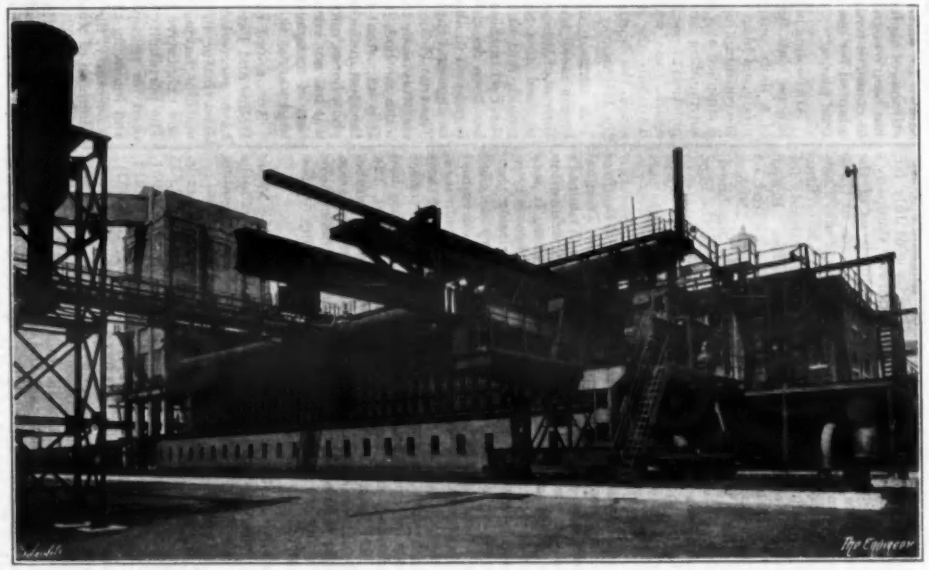


FIG. 9—PUSHER SIDE OF COKE OVEN BATTERY

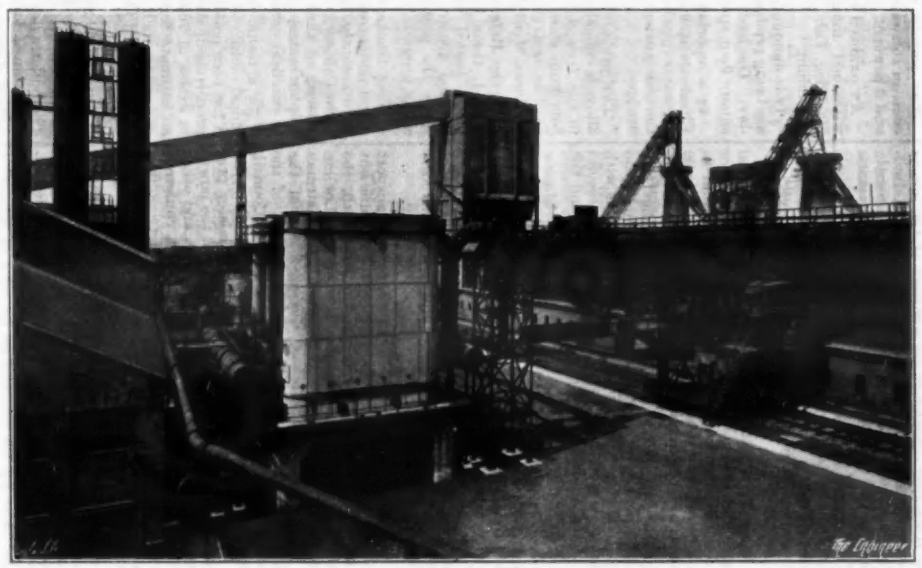


FIG. 10—GAS CLEANING PLANT AND COKE OVENS

The Engineer

JULY 22, 1932.

VOL. CLIV. No. 3993

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NOTICES TO READERS.

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IMPRESSIONS AND STATISTICS.

LOOKING back over them, most engineers would undoubtedly describe the years between 1924 and 1930 as a time of constantly deepening depression. Few would be bold or foolish enough to argue that they marked a period of advancing prosperity in the engineering industry. Yet anyone who felt inclined so to argue could derive apparently strong support for his views from the Censuses of Production taken by the Government in these two years. A preliminary report on the 1930 returns, so far as they concern the mechanical engineering trades appeared in the *Board of Trade Journal* for June 9th. From that report we take the table reproduced on page 95, in which the figures are summarised and compared with the corresponding figures obtained during the Census of 1924. It will be observed that the year 1930 surpassed the year 1924 in every respect; the gross and net outputs were of higher value, the industry spent more on its raw materials and used more power on their conversion into finished products; the number of workpeople employed was greater, and the output per person was higher. These results are in such sharp, almost in such painful, contrast with the general impression of the state of the industry during the period between the taking of the two Censuses that our first inclination is to say that they must be fallacious or be founded on some specious method of reckoning. It is certainly true that the figures as they stand are puzzling, and that even in the light of fuller details some of them cannot be very satisfactorily explained.

The figures, it may be noted, relate to private firms engaged in the production, including the repair, of mechanical plant and apparatus other than motor vehicles, cycles, aircraft, and railway carriages and wagons. They exclude engineering work carried out by Government Departments, local authorities, railway companies, and public utility undertakings. One of their most striking items is the increase recorded in the average number of persons employed. The increase, it is true, is only 2500, but that there should have been a small increase instead of a large decrease seems remarkable when we bear in mind the reductions in staffs which were constantly being reported during the period covered between the Censuses. Further investigation, while it helps to adjust the figures in the direction which we would expect them to follow, raises a fresh problem. On analysis, it is found that the increase of employment was the net result of a decrease of 1·8 per cent. in the number of operatives and an increase of 15 per cent. in the number engaged on the administrative side. Translating these percentages into actual figures, we may say that in 1930 the British mechanical engineering industry employed on the average 6300 fewer operatives and 8800 more administrators than in 1924. Put otherwise, in 1924 there were sixteen administrators to every hundred operatives, whereas in 1930 there were nineteen. This growth in the proportions of the administrative departments is interesting, in view of the fact that one of the principal claims made for the rationalisation and amalgamation schemes in which the period abounded, was the reduction of administrative staffs. That there should have been an increase seems to indicate that some preponderating counter-influence was at work. That influence, it may be suggested, was the increasing adoption of mass or quantity production methods. The effect exercised by the introduction of such methods is generally to economise in the number of producers at the expense of an increase in the number of clerks, timekeepers, and other non-producers, classified with the administrative staff. In the United States, the reputed home of these methods, there are about twenty-eight administrators to every hundred operatives. Closely connected with the numbers employed in the industry is the output per person. The Census returns are unsatisfactory under this heading in so far that the output per person is expressed in terms of value rather than of quantity. It is therefore impossible to say whether the workers in the mechanical engineering industry produced more per head in 1930 than in 1924 unless we know the relationship of the prices secured for the products in the two years. The table on page 95 shows a small—actually £8—increase in the value of the net output of each worker on the average. If that figure is a true measure of the increased output of the individual worker in the industry, it can only be regarded as disappointing in view of the increased facilities for production introduced during the period. As a measure of those increased facilities, we may take the mechanical power available in the industry. During the period, it will be noted, the available horse-power has been increased by 110,000, very largely, it may be added, by the introduction of electric motors driven by purchased current. This increased power, had it been used as productively as the power available in 1924, should have given a net output of products valued at nearly £95 million. The actual net output, as the table shows, was valued at £88 million. This argument may be criticised as unsound on the ground that it ignores the possibility that during the period the installation of additional power may have been carried beyond the requirements of the immediate trade situation for good and obvious reasons. That contention seems to be defeated by the fact that according to the returns the power in reserve or idle in 1930 was considerably less than it was in 1924.

There are many other aspects of the Census returns besides those with which we have dealt which invite comment. Enough, however, seems to have been said to show that the figures presented contain some surprising features. The year 1924, although it was marked by a strike and lock-out in the shipyards and by two strikes in the transport industry, was also the year of the first Empire Exhibition at Wembley. Unemployment in the engineering industry decreased during the year, and in most branches there was an increase in the quantity and value of exports. On the whole, it was generally characterised as a year of improving trade. The year 1930, although it was without serious industrial strife, witnessed the failure of the Imperial Conference and felt the first effects of the depression which had overtaken the United States. It was a very bad year for trade, and all over the world buying had slowed down to the point of stopping. The Census of Production figures completely reverse these two pictures. In what manner are we to explain the discrepancy? It is credible that the Census returns, in spite of the care expended on their compilation by the Board of Trade, may be fallacious as a picture of the prosperity of the engineering industry in the years 1924 and 1930. For example, the returns covered, in 1930, 3246 establishments, and therefore the aggregate figures represent the addition of a large number of small quantities. Again, the figures relate to machinery and plant completed within the year of the Census, and therefore one year may be unduly benefited and the other unduly penalised by the value of the work in progress at the beginning and at the end of the twelve months. When, however, allowance is made for these and other adjustments, the discrepancy for which we are trying to account is reduced, but not obliterated. Some other adjustment is needed. We believe it to be required in the estimates of prosperity, which we base on our general impressions rather than upon statistics. Those who are in intimate daily contact with a particular industry are apt to acquire a false perspective of its state of prosperity. For political, domestic, and psychological reasons they are prone in bad times to overestimate the depression and in good times to exaggerate the activity. Trade is never quite so bad as it seems and, probably, never quite so good as it is reported to be. By refusing to accept either general impressions or pure statistics, but by combining the evidence from both sources we shall probably arrive close to the truth.

Selling Railway Transportation.

RAILWAYS are primarily a commercial proposition. Like all trading concerns, they seek to make a profit for their proprietors. At the same time, they desire to keep an attractive establishment—that has an air of prosperity—and to have contented and reliable servants. Like, again, any other business corporation, their achievement of those ends depends, first and foremost, upon the sales of their particular commodity, which, with railway companies, is transportation. Continuing the parallel, the extent of the profits for the proprietors is subject to the amount that has first to be deducted for the carrying on of the business and the maintenance and renewal of the establishment. At this stage we must modify the comparison with an ordinary trading concern, in view of the fact that on a railway the upkeep of the establishment—by that we mean the material establishment—is such a big undertaking that it is kept separate from what we may call the sales side. Put briefly, on a railway there are, broadly, three main divisions—the earning or commercial; the operating, *i.e.*, the execution of the business secured; the means whereby that execution is performed. The first two are so interrelated that, until quite recent years, both came under the supervision of what was known as the traffic department. It was not a bad arrangement, as the same people who secured and received the traffic had to see to its dispatch and transit, and, of course, delivered it. There was, consequently, no confusion of interests. It must, however, be recognised that there is a distinction, as the obtaining and holding of business is a commercial matter, whereas its transit has more of a technical character. Thus, on the North-Eastern Railway, first, and then on the Midland, the two were at last separated, and there were set up a commercial or traffic branch and an operating; the title of the officer responsible for the latter was the general superintendent.

Both the commercial and operating sides are important. The less cost at which the business can be carried, the greater the proportion of net to gross receipts. The operations of a railway are a dominant factor in the success that follows the sale of transportation. They include the placing in the shed and loading of the wagons; the make up of the trains; the locomotive power; the number of trains and of the stations to be called at; the shunting and sorting of the wagons; the trainmen's hours of duty; the signalling and protection of the trains. It is to meet the demands of the operating department that the locomotive engineer builds certain types of engines; that the civil engineer lays out his station yards, and provides widenings, sidings, and such additional accommodation as marshalling yards; whilst the signal engineer furnishes signal-boxes and signalling appliances to suit the needs of the trains. These are all, it will be agreed, separate and distinct from the securing of passenger and goods traffic, and, to many, railway operation is more of a science than is its commercial side. The relative positions of the two branches have, however, through force of circumstances, been somewhat modified of late—partly by bad trade; partly by the serious inroad into railway revenue made by road competition; partly by the high cost of railway labour. The efforts of the operating department in the direction of securing more economical transit have produced some remarkable and quite unexpected economies, but the limit must nearly be reached. Apparently it is hoped that a little more meat can

be found on the bone, as we still hear of investigations being made and schemes prepared. Much more is, however, to be done by the commercial branch. That side of the railway business has made a great spurt since the development of road transport, and benefits, hitherto undreampt of, are offered to the public if only they will travel by rail. Some time ago the London, Midland and Scottish considerably strengthened the hands of its passenger commercial manager, and, as recently as June 3rd last, we mentioned that that company was spending a large sum of money in order to keep Mr. Ashton Davies, the gentleman just referred to, in closer touch with the divisional and district traffic superintendents. Now, however, a yet greater change has been made. Mr. Davies has been given an independent position, in which he is responsible directly to Mr. Lemon, the vice-president for traffic, operating and commercial. The new arrangement is to apply not only to passenger business, but to the goods also. The present goods manager, who was formerly on the Caledonian Railway, now becomes the company's chief officer for Scotland. The chief general superintendent has had all his commercial duties transferred to Mr. Ashton Davies, and becomes the chief operating manager.

We hope that reading between the lines of what we have written above, it will be appreciated that we do not consider that the greater attention that is to be paid to the commercial side on the L.M.S. implies the belittling of the companion operating section, the importance of which remains unaffected. That has not always been so. It is safe to say that the antagonism of traders to the railways—which began in the late 'seventies and reached its height in the early 'nineties—was due to the relations with the public passing out of the hands of practical railwaymen like Gooch, Allport, Mark Huish, and Archibald Scott, into the hands of men whose views where almost limited to the question of rates, fares, and other charges, and who were eternally wrangling with their customers. The situation became very much happier when the present century brought a new class of men to the head of affairs, and the purely traffic man was replaced by engineers like Sir James Inglis, Sir John Aspinall, Sir Arthur Watson, and Sir Henry Thornton, and by lawyers of the standing of Sir Guy Granet, Sir George Gibb, Sir Alexander Butterworth, and Mr. George Davidson. What now makes for the success of the changes on the London, Midland and Scottish is that Mr. Ashton Davies and Mr. Byrom come under the vice-presidency of Mr. Lemon, whose fitness for his own office, and the general question of engineers as administrators we discussed in our editorial columns on March 4th last.

Literature.

Production Planning. By CLIFTON REYNOLDS. Sir Isaac Pitman and Sons, Ltd., London. 1932. Pp. 229. Price 10s. 6d. net.

IT is becoming increasingly a habit to regard production planning as one of the many functions that contribute to the development of manufacture, but in the book before us the author contemplates a much broader field, involving the whole problem of the organisation of production.

The subject is divided into three main sections: planning for sale, planning for economy, and planning for co-ordination; again subdivided into a number of chapters, each dealing with a particular phase of the subject.

The method of booking an order and all the clerical work involved, as well as considerations as to packing and dispatch, are very clearly discussed, and useful suggestions are made. But it is probably Part II. which will prove of most interest to the engineer, who will heartily agree with the author when he affirms that "an efficient works manager bases his promises upon facts, not upon hopes." The means of keeping an eye on these promises advocated by the author should prove as efficient as it is simple. Each order is represented by a cardboard disc which is hung on an appropriate hook to indicate the date for completion, and a movable line across the board shows the present date. All cards to the left of this line graphically tell the tale of broken promises, and thus give a constant reminder to all who are interested. Suitable visible indicators are favoured for the stores and offices generally, which are almost self-explanatory, and much can be effected by an intelligent use of them.

Too often the first step taken in reorganising a works is to reduce the cost of labour, and it is refreshing to read that "it would seem that the scientific control of overhead charges may be even more important than the scientific control of labour charges"—a statement with which we are heartily in agreement. At the same time, we are not fully convinced that all the economies proposed would prove to be genuine savings. For example, it is not considered wise to say, in connection with the passing of materials for use in the works, that "simple tests . . . even though they are of a distinctly technical nature, may be entrusted to an intelligent receiving man" rather than to a higher paid official. It is felt that all inspection should be under the control of one technical man, who could then use his assistants to the best advantage.

In examining the important subject of waste in a factory, the author draws an arbitrary line of division between normal time-wasting and the abnormal, and intimates that the former provides scope for obvious planning remedies. When he places the time spent on fetching tools, materials, drawings, &c., with the waiting time involved, in the normal category we cannot help feeling that he must have in mind a somewhat inefficient works, as one of the axioms of a well-organised undertaking should be that all materials, jigs, tools, drawings, and other necessities for manufacture must be on the shop floor at the time when they are required. Waiting time due to some lapse should clearly be recorded, and steps taken to obviate it.

The value of keeping strict control on work in progress is rightly stressed, for much harm may result from laxity in this direction. Another fruitful source of trouble is to be found in the interruption of work, and making promises of delivery in a short time, without considering all the facts, and the effect of one such promise on all the other orders that are being prosecuted.

In Part III. the important subject of cost accounting is introduced, and some of the principal methods are sketched, but hardly enough is said to enable one who is not conversant with the rudiments to understand all the principles involved and the pitfalls to be avoided. The more exact the cost accounting is, the more useful will it prove to the management, and for this reason alone, even although it may be true that the "departmental subdivision of overheads places a burden of routine work," we deprecate the conclusion that "it may be avoided." It is better to face the routine work and ensure results as nearly accurate as is humanly possible.

In organising for the purchase of stores, in addition to the determination of a maximum and minimum, we should like to see provision made for establishing an "ordering level." This will prove a valuable asset to good storekeeping.

In "Production Planning," Mr. Reynolds has very usefully outlined the methods necessary for a factory employing about 1000 workers, and it should prove useful to all those engaged in management. Students whose aspirations lie in the direction of this branch of their profession could not do better than study this book, and so gain a bird's-eye view of the magnitude of the problem before them. Obviously, it was not possible to furnish detailed descriptions of the many activities that are involved, but it would be of great assistance if references had been given to suitable literature where each subject is dealt with more exhaustively.

In conclusion, we must note one omission, which we consider a serious one. The author has not clearly indicated the relative importance of the different functions, nor their relation one to the other. This could readily be accomplished by the insertion of a sort of "family tree" from the chairman of the board down to the lowest official. Too often an apparently efficient organisation fails because of unnecessary overlap of duties. The suggestion that conferences help to obviate difficulties of the sort visualised is admittedly true, but these very conferences will be sadly handicapped unless a definite ruling has already been given as to the scope covered by each member of the staff. At the time of appointment, the degree of responsibility should be thoroughly explained. Successful production planning involves hearty co-operation and an intelligent appreciation of the other man's difficulties.

Photogrammetry. Edited by O. VON GRUBER, D.Ph. Translated from the German original by G. T. MCCAW, M.A., and F. H. CAZALET. London: Chapman and Hall, Ltd. 1932. Price 30s.

THE work of seven contributors and mainly compiled from the sixth vacation course of lectures on Photogrammetry, held at Jena in 1929, these "collected lectures and essays," as they are described in the sub-title, are presented as a balanced and consistent treatise of thirteen chapters, for six of which Dr. Gruber is himself responsible.

The Jena vacation courses, five of which were held in the years preceding the war, were founded in 1909 by the late Dr. Carl Pulfrich, author of forty contributions to stereoscopy, 1900 to 1923, including the article on "The Stereoscope" in the "Encyclopædia Britannica," 1910. While due consideration has been given to other sources of information or inspiration, the character of the work as a successful presentment of the elements of the subject and of the development of the art of photogrammetry may largely be due to this basis of ordered discussion of problems, at earlier stages in some sort corresponding to those through which a student of the subject must to-day pass. In a more important aspect, and as relating to a subject which has undergone rapid development since 1914, the book is to be considered as an exposition of the primary relations of distances and angles which form the basis of photogrammetry, the means by which the records are taken, and the many and various optical and mechanical devices and apparatus whereby the records are made to yield measurements. In all these respects the treatment is very thorough; problems are clearly stated, the general idea underlying a method or group of methods of its solution explained, the design of the apparatus described, mathematically and mechanically, and the nature and the degree of reliability of the results discussed. Diagrams and other illustrations are liberally employed as aids to this exposition and description.

The book begins well, from the point of view of a reader commencing a study of the subject, with a short chapter on the aims and problems of topographical photogrammetry, in which there are presented clear ideas as to the nature of ground and of air operations.

Specially interesting to engineers are the chapters on Ground Photogrammetry and one describing a portable photo-theodolite, and its use in the Alai-Pamir expedition of 1928. The work included the mapping of 3750 square miles of the north-west border range of the Pamirs, with peaks up to 23,000ft. in altitude, besides surveys for special maps of parts of the region. In six weeks the whole area was covered by a trigonometrical net comprising forty points at altitudes between 4500ft. and 6000ft.

Operational methods and "production" (? results) are described, separately, for ground and for air surveys. A chapter on the efficacy of photogrammetry for precision and economy, with special reference to the needs of civil engineers, includes the following significant passage:—"With a lightness of heart amazing to anyone who knows anything about topographical maps, the uses to which they may be put and their reliability, the plane-table sheet is seized upon as the unique plan at one's disposal for contours, and is acclaimed as the basis for laying out work. Even tenfold enlargement (in superficies 100-fold) is usually accepted therefrom without any hesitation whatever—enlargement by the simplest means."

The costs of photogrammetric surveys are given for a number of cases. The German Land Survey Office estimates the cost of the 1 to 5000 scale maps as roughly 1000 R.M. per square kilometre, or £129 per square mile at par.

While the chapter describing some of the Zeiss lenses designed for photogrammetrical work amounts to an explanation of the part played by the lens and the significance of aberration, astigmatism, distortion, and so forth, that on the requirements for the construction of rotating disc shutters and the realisation of those requirements, 47 pages, with many mathematical studies, may seem an unduly lengthy and detailed discussion of this apparatus detail, important though it be. This is, however, the only chapter as to which such criticism may be made in an otherwise well-balanced treatise.

The volume is very well illustrated, the reproductions of photographs being especially good, surpassingly so in the case of many of the instruments so depicted. Since the translation shows no sign of halting or slurring, and is throughout in flowing and rhythmic English, it may be accepted that Mr. McCaw and Mr. Cazalet have well performed the important task of making available for English readers this valuable and timely treatise, which is the first German book on the subject to be translated into English.

SHORT NOTICES.

Dielectric Phenomena. By S. Whitehead, with a preface by W. B. Wedmore. London: Ernest Benn, Ltd. Price 30s.—This volume is the third of a series being prepared by the British Electrical and Allied Industries Association, giving a critical *résumé* of the available information on the subject of dielectric phenomena with special attention to the theoretical basis and reference to the failure of insulation in service. Previous volumes have dealt with the phenomena in gases and liquids, but the present book considers the breakdown of solid dielectrics. Solid insulators as used in practice are shown to be complex bodies subject to phenomena of a most involved and confusing character. It is hoped, however, that the book will help to remove much of this confusion and that further study will lead to greater simplification and the production of materials and methods of use giving more uniform and effective performance. As in the case of the previous volume, experimental evidence is followed by a study of available theoretical work. Theories of the breakdown of solid dielectrics occupy no fewer than ninety-five pages of the book. Other sections deal with the nature of breakdown, time effects, the influence of electrode arrangement upon the breakdown voltage, the breakdown of combined dielectrics, surface discharges, the effect of frequency and wave form, and the effect of temperature and moisture. Although the book may not appeal to the average electrical engineer to a very marked extent, the insulation specialist and research worker will probably find it a great help.

Wiring Systems. By L. M. Waterhouse. London: Gee and Co., Ltd. Price 5s.—In view of the various wiring systems now available and the diversity of opinion among engineers as to the relative merits of "all earthed" systems, such as those involving the use of screwed conduit or lead alloy sheathed cables, as against an all-insulated system with tough rubber cables and the latest types of Bakelite boxes, this book is welcome. The author's aim has been to outline a number of the most prominent

systems available and to refer to the leading features of each in order that the reader may decide to what extent the different systems can be adopted to comply with individual cases. Although a large portion of the book is devoted to metal conduit wiring, the alternative systems have been given a fair show and the names of the firms supplying the materials for these systems are mentioned. Many useful hints are given concerning wiring work generally, and a cable card accompanying the book enables the size of conduit necessary for any given circuit to be readily ascertained.

Alternating Current Bridge Methods. By Dr. B. Hague. London: Sir Isaac Pitman and Sons, Ltd. Price 15s.—The third edition of this book calls for little comment. Apart from a few minor corrections, the main text has been reprinted unaltered, but owing to the large amount of new work on A.C. bridge measurements, some account of these recent developments is given in supplementary notes at the end of the volume. These notes also include further treatment of certain subjects dealt with in the text, and it is hoped that the new material will add to the general usefulness of the volume. For the benefit of those unfamiliar with the earlier editions we may say that the book deals with A.C. bridge measurements of inductance, capacity, and effective resistance at low and telephonic frequencies in a manner suited to the needs of advanced electrical students.

BOOKS RECEIVED.

Earth Dam Projects. By J. D. Justin. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 31s. net.

Protective Films on Metals. By E. S. Hedges, M.Sc., &c. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 15s. net.

Acoustical Engineering. By W. West, B.A., A.M. Inst. C.E. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 15s. net.

Architectural Graphic Standards. By C. G. Ramsey and H. R. Sleeper. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 37s. 6d. net.

A Record Run on the London, Midland and Scottish.

By HUMPHREY BAKER.

AMONG the many accelerations of express trains in Great Britain this summer, none are more notable than those made by the London, Midland and Scottish Railway Company from Liverpool and Manchester to London, by which the best time has been reduced to 3 hours 15 minutes, with one intermediate stop, for the 188½ miles from Manchester to Euston, and 3 hours 20 minutes, with two stops, for the 193·7 miles from Liverpool, equal to 58·0 m.p.h. overall in each case. The start to stop runs at over 60 m.p.h. which form part of these journeys—from Wilmslow to Euston at 61·7 m.p.h. by the 9.45 a.m. train from Manchester, and from Crewe to Willesden at 64·5 m.p.h. by the 5.25 p.m. from Liverpool—both break existing records for regular schedules, the former being the longest start to stop journey at over 60 m.p.h. in the world, and the latter the fastest in Europe for any distance over 100 miles. Its nearest rivals on this side of the Atlantic are the runs made by the London and North-Eastern Railway from Grantham to King's Cross, 105·5 miles, at 63·3 m.p.h.; the Northern Railway of France from Paris to Aulnoye, 133·9 miles, in 127 minutes, or at 63·2 m.p.h.; and to Arras, 119·4 miles, in 114 minutes, at 62·8 m.p.h.; and the Great Western Railway from Paddington to Bath, 106·9 miles, in 102 minutes, also at 62·8 m.p.h.

The Crewe-Willesden achievement beats all these by a clear margin (though itself in turn beaten by the 68·9 m.p.h. of the Canadian Pacific "Royal York" express between Smith's Falls and Montreal West) and is the more noteworthy because of the great amount of acceleration which it involves as compared with the best time previously scheduled over the same stretch of line. Hitherto the quickest time from Crewe to Euston has been 169 minutes without a stop; but the new train takes only 153 minutes, including the halt at Willesden, equivalent to 149 minutes non-stop, or 20 minutes gained in the running. As compared with the best time of thirty years ago, the saving in time between Manchester and London is an hour.

That the new scheduled times can be maintained in practice with a substantial margin for delays was made abundantly clear last Monday—the first day of the accelerated running—when the 9.45 a.m. from Manchester ran the 176·9 miles from Wilmslow to Euston in 165 minutes 15 seconds (6¼ minutes under time), or at 64·2 m.p.h., taking just under 138 minutes from Crewe to Willesden, with 375 tons, and the 5.25 p.m. from Liverpool made the times between Crewe and Willesden which are recorded below.

For the purpose of the log the timing points selected are those which best indicate the work done by the engine, having regard to the gradients. No extreme speeds were reached, or indeed attempted, 80 m.p.h. being touched or exceeded only for short distances at four points; on the 1 in 330 down after Lichfield and on the similar gradients between Welton and Blisworth, near Castlethorpe, and between Harrow and Wembley. Perhaps the most striking feature of the run was the start to Whitmore, all uphill, on which 60 m.p.h. was attained just beyond 4 miles out, up 1 in 269, and this rate or a little more was then sustained up the 1 in 117 between mileposts 153½ and 150.

The recovery from slacks was also rapid; for example, after the slowing to 36 m.p.h. at Trent Valley Junction (Stafford) speed reached 60 again in a mile and a-half, while after the service slack through Rugby to about 40 m.p.h. it recovered to 60 in 3 miles up the 1 in 370 towards Kilsby Tunnel. The average for the uphill section from Bletchley to Tring, finishing with 6 miles up 1 in 333, was 73·7 m.p.h.—another excellent figure—and only 1·5 miles an hour less than the rate for the 20 miles of down grades, mostly at a similar inclination, between mileposts 30 and 10, on which the train was carefully controlled.

The overall speed for the whole run was 66·9 m.p.h., while from Crewe to milepost 8 it was 67·7 and from milepost 128 to the same point 70·8.

It is satisfactory to know that these accelerations are only a prelude to others, and that in September the new standard of speed is to be applied to other trains between London and Manchester and Liverpool, in both the up and down directions of running. On important business services such as these time is of the essence.

6.12 p.m., *Crewe to Willesden, July 18th, 1932. Engine No.* 6140, "*Hector*," "*Royal Scot*" *Class. Driver, J. Farrell; Fireman, J. Pritchard, Liverpool. Load:* 262 *Tons Tare,* 295 *Loaded.*

Distance, miles.	Stations, &c.	Time, mins. secs. and fifths.	Speed point to point, m.p.h.
0·0	Crewe .. .. .. dep.	0 00	—
1·1	Milepost 157 .. .. pass	2 41/4	24·4
2·1	,, 156	3 59/4	46·1
3·1	,, 155	5 9/0	52·0
4·1	,, 154	6 10/3	58·4
5·1	,, 153	7 10/3	60·0
6·1	,, 152	8 10/0	60·6
7·1	,, 151	9 10/0	60·0
8·1	,, 150	10 9/3	60·4
9·1	,, 149	11 8/2	61·2
10·1	,, 148	12 5/4	62·7
10·5	Whitmore	12 32	—
13·1	Milepost 145	14 44/2	68·1
18·1	,, 140	18 51/1	72·9
23·1	,, 135	23 18/0	67·4
24·5	Stafford (*a*)	24 50	—
28·1	Milepost 130 (*b*)	29 26/1	48·9
33·1	,, 125	33 52/1	67·6
33·8	Rugeley	34 28	—
38·1	Milepost 120	38 0/0	72·6
41·1	,, 117 (*c*)	40 30/0	72·0
41·8	Lichfield	41 06	—
46·1	Milepost 112	44 19/4	78·2
48·1	Tamworth	45 54	—
50·1	Milepost 108	47 34/4	73·8
52·1	,, 106 (*d*)	49 54/2	51·5
53·1	,, 105	50 59/3	55·2
54·1	,, 104	51 58/0	61·6
55·1	,, 103	52 54/3	63·5
56·1	,, 102	53 51/1	63·5
58·1	,, 100	55 37/4	67·5
60·1	,, 98	57 20/1	70·3
61·0	Nuneaton (*e*)	58 08	—
62·1	Milepost 96	59 4/3	68·9
63·1	,, 95	59 58/3	66·6
64·1	,, 94	60 53/0	66·1
65·1	,, 93 (*f*)	61 47/4	65·6
68·1	,, 90	64 22/0	70·0
73·1	,, 85	68 29/1	72·9
75·5	Rugby (*g*)	71 08	—
77·1	Milepost 81	73 15/4	50·2
78·1	,, 80	74 22/1	54·2
79·1	,, 79	75 23/3	58·6
79·8	,, 78¼	76 7/4	61·0
82·8	Welton (*h*)	78 53	—
83·1	Milepost 75	79 6/3	65·4
88·1	,, 70	83 1/3	76·5
88·4	Weedon (*i*)	83 15	—
93·1	Milepost 65	86 57/4	76·2
94·1	,, 64	87 45/2	75·6
95·3	Blisworth (*k*)	88 41	—
96·1	Milepost 62	89 21/0	75·3
97·1	,, 61	90 11/4	70·8
98·1	,, 60	91 3/3	69·4
98·2	Roade (*l*)	91 09	—
103·1	Milepost 55	94 58/0	76·7
105·1	,, 53	96 27/1	80·7
105·7	Wolverton (*m*)	96 57	—
108·1	Milepost 50	98 46/4	77·3
111·4	Bletchley	101 29	—
113·1	Milepost 45	102 49/1	74·2
117·9	Leighton Buzzard (*n*)	106 45	—
118·1	Milepost 40	106 53/2	73·8
120·1	,, 38 (*o*)	108 29/2	75·0
123·1	,, 35	110 58/1	72·7
125·1	,, 33	112 42/3	68·9
126·1	,, 32	113 36/2	66·9
126·4	Tring (*p*)	113 53	—
128·1	Milepost 30	115 21/2	68·4
133·1	,, 25	119 22/2	74·7
134·1	,, 24	120 9/0	—
138·1	,, 20	123 20/1	75·6
140·7	Watford	125 24	—
143·1	Milepost 15	127 22/2	74·4
146·7	Harrow	130 17	—
148·1	Milepost 10	131 18/1	76·2
150·1	,, 8	132 56/2	73·3
152·7	Willesden .. .. .. arr.	136 53	39·4

NOTES.

(*a*) Service slack, Trent Valley Junction, 36 m.p.h.
(*b*) Grades undulating to post 117¼.
(*c*) Falling at 1 in 331, &c., to post 112.
(*d*) Slack, 45 m.p.h. Rising to post 101¾, 1 in 321, &c.
(*e*) Rising at 1 in 320 to post 93¾.
(*f*) Undulating to Rugby.
(*g*) Service slack, 40 m.p.h. Rising at 1 in 370 to post 78¼.
(*h*) Falling at 1 in 415, 350, 490 to Weedon.
(*i*) Level to Blisworth.
(*k*) Rising at 1 in 320 to post 61.
(*l*) Falling at 1 in 330, 410, &c., to Wolverton.
(*m*) Rising slightly to Leighton.
(*n*) 1¼ miles down at 1 in 1330.
(*o*) Rising at 1 in 333 to post 32.
(*p*) Falling, mainly at 1 in 335–340, to Wembley. Slight rise for a mile beyond Watford.

A Parable.*

By D. B. STEINMAN, President of the Society of Professional Engineers, New York.

ONE day three men—a lawyer, a doctor, and an engineer—appeared before St. Peter as he stood guarding the pearly gates.

The first man to step forward was the lawyer. With confidence and assurance, he proceeded to deliver an eloquent address which left St. Peter dazed and bewildered. Before the venerable Saint could recover, the lawyer quickly handed him a writ of mandamus, pushed him aside, and strode through the open portals.

Next came the doctor. With impressive, dignified bearing, he introduced himself: "I am Dr. Brown." St. Peter received him cordially. "I feel I know you, Dr. Brown. Many who preceded you said you sent them here. Welcome to our city!"

The engineer, modest and diffident, had been standing in the background. He now stepped forward. "I'm looking for a job," he said. St. Peter wearily shook his head. "I am sorry," he replied, "we have no work here for you. If you want a job you can go to hell." This response sounded familiar to the engineer, and made him feel more at home. "Very well," he said, "I have had hell all my life and I guess I can stand it better than the others." St. Peter was puzzled. "Look here, young man, what are you?" "I am an engineer," was the reply. "Oh yes," said St. Peter. "Do you belong to the Locomotive Brotherhood?" "No, I am sorry," the engineer responded apologetically, "I am a different kind of engineer." "I do not understand," said St. Peter, "what on earth do you do?" The engineer recalled a definition and calmly replied: "I apply mathematical principles to the control of natural forces." This sounded meaningless to St. Peter, and his temper got the best of him. "Young man," he said, "you can go to hell with your mathematical principles and try your hand on some of the natural forces there!" "That suits me," responded the engineer, "I am always glad to go where there is a tough job to tackle." Whereupon he departed for the nether regions.

And it came to pass that strange reports began to reach St. Peter. The celestial denizens, who had amused themselves in the past by looking down upon the less fortunate creatures in the Inferno, commenced asking for transfers to that other domain. The sounds of agony and suffering were stilled. Many new arrivals, after seeing both places, selected the nether region for their permanent abode. Puzzled, St. Peter sent messengers to visit hell and to report back to him. They returned, all excited, and reported to St. Peter:

"That engineer you sent down there," said the messengers, "has completely transformed the place so that you would not know it now. He has harnessed the fiery furnaces for light and power. He has cooled the entire place with artificial refrigeration. He has drained the lakes of brimstone and has filled the air with cool perfumed breezes. He has flung bridges across the bottomless abyss and has bored tunnels through the obsidian cliffs. He has created paved streets, gardens, parks, and playgrounds, lakes, rivers, and beautiful waterfalls. That engineer you sent down there has gone through hell and has made of it a realm of happiness, peace, and industry!"

SIXTY YEARS AGO.

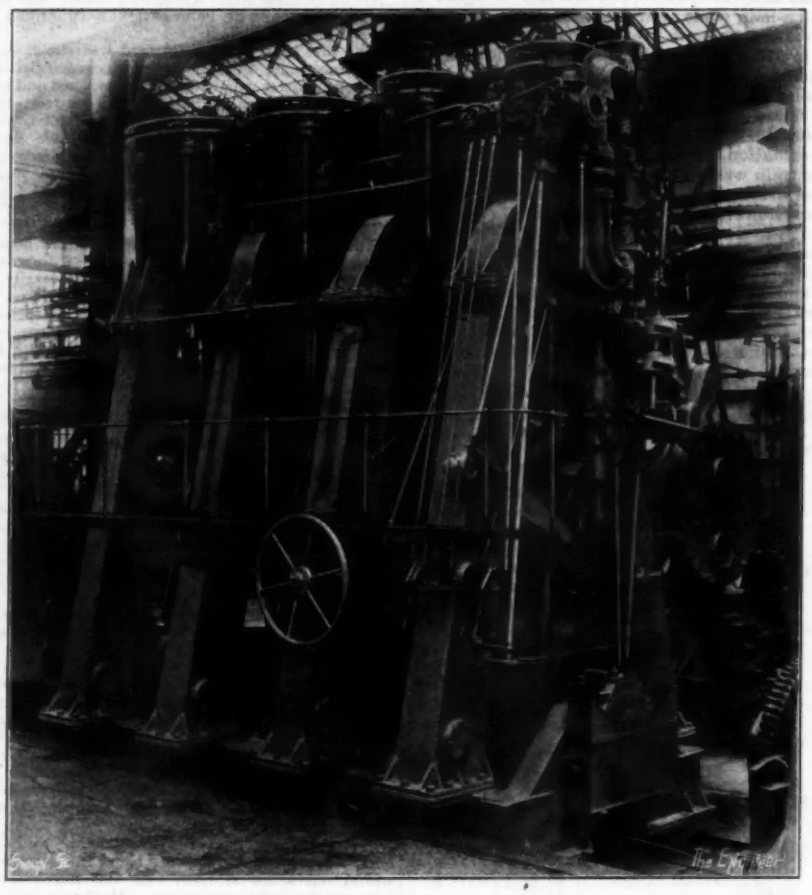
IN our issue of July 26th, 1872, we recorded the death of Mr. W. Bridges Adams, an eminent engineer, who in his day was widely known in the railway world. Mr. Adams was born at Madeley, North Staffordshire, in 1797, and was therefore in his seventy-sixth year at the time of his death. He was articled to John Farey, and from him gained an extensive knowledge of mechanism and the steam engine. As a young man he was delicate, but a sojourn in Chili and other countries of South America established his health, and he duly returned to this country a strong man. For a short time he was connected with his brother in his father's business, Hobson and Co., the carriage makers of Long-acre, London. Thereafter, he established the Fairfield Carriage Works at Bow, where he applied steam machinery to the processes of manufacture. His first railway connection appears to have been established with the invention and patenting of the fish joint, "now used wherever railways are known." Other railway work followed. He laboured hard and successfully at the improvement of rolling stock, and in particular devoted his attention to brakes, elastic tires, and radial axles. He also introduced improvements in rails and "the economical distribution of iron in them," with a view to improving their economy in wear. Mr. Adams was a prolific writer on engineering and allied subjects, and in his day was a frequent contributor to our own columns, as well as to other journals and to the transactions of learned societies. In addition, he wrote two books, one of which is noteworthy for the comprehensiveness of its title, while the other bears a title with a very modern sound about it. In 1837 he issued through Knight and Co. a work entitled "English Pleasure Carriages: their Origin, History, Varieties, Construction, Defects, Improvements, and Capabilities." In 1862 he issued a portly volume, published by Chapman and Hall, entitled "Roads and Rails: and their Sequences, Physical and Moral." At the time of his death he had under consideration plans for the construction of improved trading vessels, cross-Channel vessels, tramways, and hot air engines for use on the streets.

THE Government of India will shortly publish a booklet giving a description of the headworks at Mettur Dam and also the possibility of establishing industries in that area, with a view to attracting offers for the purchase of the machinery and buildings put up there in connection with the project, which is expected to be completed in September, 1934. The book will be distributed free both in India and England, and if necessary in other countries.

* *The American Engineer.*

2100 I.H.P. HIGH-PRESSURE "QUADROPOD" MARINE ENGINE

MR. MAURICE S. GIBB, M.I. MECH. E., WEST HARTLEPOOL, ENGINEER



The "Quadropod" High-Pressure Marine Steam Engine.

ON Tuesday last, July 19th, we inspected under steam at the Central Marine Engine Works, West Hartlepool, the first "Quadropod" high-pressure marine steam engine, which has been designed by Mr. Maurice S. Gibb, the managing director of the company, and his technical staff, and installed in the "Kepwickhall," an 8600-ton cargo steamer built by William Gray and Co., Ltd., to the order of the West Hartlepool Steam Navigation Company, Ltd., which has undergone satisfactory basin trials.

The "Kepwickhall" is equipped with three boilers, working at a pressure of 260 lb. per square inch, and equipped with smoke tube superheaters, designed to give a superheat of 180 deg. Fah., and a total steam temperature of 590 deg. Fah. Howden's system of forced draught is fitted, together with "C M E W" super air-preheaters.

We noted that a complete installation of the firm's auxiliaries has been provided. It includes a Michell pattern thrust block, a centrifugal circulating pump driven by a single-cylinder open-type engine, a pair of vertical simplex independent feed pumps, an exhaust steam feed heater, and a high-pressure surface feed heater, a winch condenser, a vertical duplex general-service pump, a vertical duplex ballast pump, an evaporator, a gravitational filter, a combined drain and scum tank, with boiler circulators and boiler steam separators. The feed-water system has been so arranged that the feed water is brought up to a temperature of about 300 deg. Fah. by the two feed heaters before it enters the boilers.

The "Quadropod" engine is a four-cylinder quadruple-expansion engine in which special features have been introduced in order to obtain the lowest possible steam consumption, simplicity in design, reliability in operation, and low maintenance costs.

The name "Quadropod" is a registered one, and Mr. Gibb informed us that it has been compounded out of "quadruple," referring to the expansion; "drop," referring to the type of valves employed; and "odd," signifying the fact that the engine is different from the accepted form of quadruple-expansion engine design. The principal difference between the engine and an ordinary quadruple or triple-expansion engine is the patented system of steam distribution and the substitution of cam-actuated drop valves on each cylinder in place of the usual slide or piston valves.

The four cylinders form two units, of which the H.P. and the first I.P. cylinders comprise the first unit, and the second I.P. and L.P. cylinders the second unit, a steam receiver being fitted between them. The steam is admitted to each end of the H.P. cylinder by the opening of a drop inlet valve, and after the closing of this valve at the point of cut off, it expands until released near the end of the stroke by the opening of a drop exhaust valve. This valve is arranged to act also as the inlet valve for the first I.P. cylinder, into which the steam passes direct from the H.P. cylinder, a receiver being unnecessary as the cranks of the H.P. and first I.P. cylinders are placed at 180 deg. to each other. Expansion is continued with the two cylinders in open communication until the H.P. exhaust valve closes at a point which gives the necessary compression in the H.P. cylinder, thus cutting off the admission of steam to the first I.P. cylinder, after which expansion still proceeds in this cylinder until the steam is released into the receiver by the opening of the first I.P. exhaust valve. The cycle of operations is repeated in the second I.P. and L.P. cylinders, which form the second unit, steam being taken from the receiver and finally exhausted.

The two cranks of each unit are placed at 180 deg. to each other, and at 90 deg. to those of the other unit, so that the four cranks of the engine are placed at intervals of 90 deg. This gives a very even turning moment, and as only one set of valve excentrics is needed at the centre of the engine and another at the forward end, even with the large main bearings provided, the engine length is only about 20ft., or over 2ft. shorter than an ordinary quadruple-expansion engine. This point was made very clear to us in the erecting shop, where we saw a "Quadropod" engine in course of erection alongside a quadruple-expansion engine fitted with drop valves on the H.P. and first I.P. cylinders, and slide valves on the second I.P. and the L.P. cylinders, a type of engine which is giving, we were informed, excellent results on the "Hartington" and other steamers of Messrs. J. and C. Harrison's fleet, which have been recently equipped with this type of propelling machinery. The high-pressure cylinder is at the front end of the engine—shown to the right of the adjacent engraving. The diameter of the H.P. cylinder is 20in., the other cylinders being:—First I.P. 28½in., second I.P. 41½in., and L.P. 61in. diameter respectively, with a common stroke of 48½in. The engine is designed for a maximum output of about 2100 I.H.P. at 80 r.p.m., corresponding to a ship's speed of about 10½ knots. As the "Kepwickhall" was moored at the firm's fitting-out berth, the engines were not demonstrated at quite their full speed, but at the time of our visit they were running at about 75 r.p.m. very smoothly.

The drop valves are an essential feature in the design, and their arrangement is clearly indicated below. The H.P. and first I.P. valves—seen to the left below—are driven by a 3in. diameter rocking shaft, which is given an oscillating motion by a crank and connecting-rod—shown to the extreme left of the engraving—which is attached to a push-rod driven by link motion gear arranged below in the usual manner. In the case of the second I.P. and L.P. valves—shown to the right below—a separate rocking shaft is provided for each of the second I.P. lower valves and the L.P. exhaust valves, the second I.P. upper valve shaft being driven by a second set of link motion gear, which transmits motion to the other rocking shafts by an arrangement of rods and cranks. The design of the cams, which are case-hardened, is such, we noted, that they are capable of individual adjustment, which controls the timing of each valve, while the cut-offs of all the cylinders may also be varied simultaneously by linking up the Stephenson valve gear. The cam rollers are each attached to a steel plunger block, moving in a robust guide, the top of the block transmitting the cam motion to a tappet nut on the end of the valve spindle, which is thus relieved from all side thrust. The valves and cages and seatings are made from special heat-resisting cast iron and Firth stainless steel spindles are used, which pass through long unpacked sleeves forming part of the cage. The fine ground fit of the spindle in the sleeve prevents any escape of steam. A feature of the design is the arrangement within the cages of tangential ribs, which guide the entering steam and assist in slightly turning the valve each time it is raised, thereby making an even seating. The H.P. valves are 8in. diameter, the first I.P. 10in., and the second I.P. 14in., the lifts varying from ⅜in. to 1⅛in. The valve cages are free to expand in their chambers, and they also form the covers of the steam chests to which they are bolted. The valve, its spindle, and the compression spring which reseats it, can be withdrawn in one unit, and provision is made to adjust the compression of the spring by means of a nut. All the valves and also the H.P. and first I.P. pistons are mechanically lubricated, and, as seen above, the lubricators are conveniently placed on the columns at the front of the engine. The engine is equipped with link driven air and bilge pumps worked from the L.P. crosshead.

The patented system of steam distribution in the "Quadropod" engine we have described reduces the receiver loss, as only one receiver is required, and the number of drop valves needed is four less than for a normal quadruple-expansion engine. Tests have indicated that the power required to drive the valves is less than that for piston and slide valves, thereby enabling a high mechanical efficiency to be attained. The tests so far made, indicate that it is likely that the engine will have a steam consumption at sea corresponding to 1 lb. of good coal per I.H.P. hour. The further trials of the engine which we have described will be awaited with interest.

BACK VIEW OF ENGINE SHOWING DROP VALVE GEAR

and Mr. Gibb and his firm are to be congratulated on the production of a new design of engine which in these difficult days offers to the shipowner an economical steam power installation at a moderate cost, with low maintenance charges, making possible a highly economical steamer for cargo transport.

A Motor Converter Sub-station at St. Pancras.

THE St. Pancras Borough Council's Arlington-road sub-station, which was officially opened last week, constitutes a good example of a modern installation of motor converters. Each of the British Thomson-Houston machines shown in the accompanying illustrations has a normal capacity of 2500 kW at 450/510 volts and is supplied with three-phase 50-cycle current at 5000/5300 volts. Following a full-load run each machine will give an overload of 25 per cent. for two hours, 50 per cent. for fifteen minutes, and 100 per cent. for fifteen seconds. After a full-load run the temperature rise was guaranteed not to exceed 80 deg. Fah. and 90 deg. after two hours' run at 25 per cent. overload. Careful tests are said to have shown that the converters are easily able to meet these condition and to comply with all other requirements. As the D.C. portion of each set has eight poles and the A.C. section four, the synchronous speed is 500 r.p.m. In spite of the fact that this speed is somewhat high, the sets are said to be quiet in operation, but in order to avoid any noise or vibration being transmitted through the foundations rubber roundels have been placed under the baseplates.

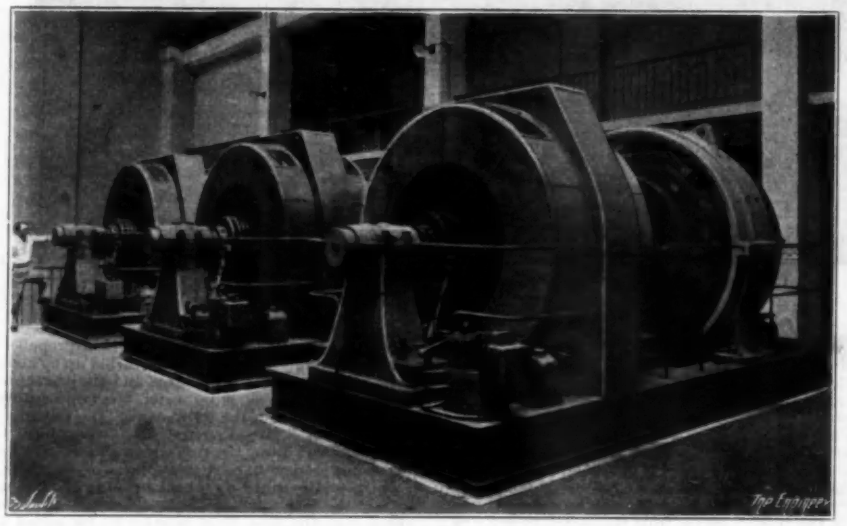
Voltage regulation is obtained by operating the field rheostat, which has the well-known effect of causing the incoming current to lag or lead and thus to cause the reactance voltage to act with or against the A.C. supply pressure and so increase or decrease the pressure at the commutator. The power taken from the A.C. mains by machines of this type is, of course, transmitted to the D.C. end partly as mechanical and partly as electrical power for the rotating elements are both mechanically and electrically coupled. Leads are taken from the A.C. rotor through the centre of the shaft to the D.C. armature, which, deals with the current transmitted in this way by acting as a rotary converter. The balance of the power, which in the case of the machines under consideration amounts to about 33 per cent. of the total, is transmitted mechanically through the shaft, and the A.C. and D.C. sections of the machine deal with this power by acting as a motor and generator respectively. Each machine has three bearings and the centre one carries a short hollow coupling shaft, an arrangement which facilitates handling by reducing the weight and size of the parts that have to be lifted and allows ample stiffness to be obtained without employing shafts of unduly large diameter. Although each set weighs 45 tons complete, the heaviest part weighs less than 10 tons.

As the three-phase stators are wound to withstand a test pressure of 15,000 volts for fifteen minutes, there is an ample factor of safety on the H.T. side. The A.C. rotors are wound twelve-phase and three of the phases are connected to slip rings for starting purposes, whilst the inner ends of all the rotor phases are brought out to a ring of contacts and after synchronism has been obtained they are short circuited to form a neutral point. Originally the machines were built for manual control, but they were afterwards equipped for automatic control, the method of starting being to connect a bank of resistances across the slip rings so as to produce a torque as in the case of an induction motor. As the speed increases the D.C. armature generates a voltage at a gradually increasing frequency, whilst the frequency of the current in the rotor decreases. At synchronous speed the armature and rotor frequencies have the same value, thus resulting in the production of a synchronising torque which is increased by substituting reactance coils for the resistances connected to the slip rings. When synchronism is definitely indicated by the rotor current falling to a low value the short-circuiting gear is brought into action and all the inner ends of the twelve phases are connected together and to the neutral on the D.C. side.

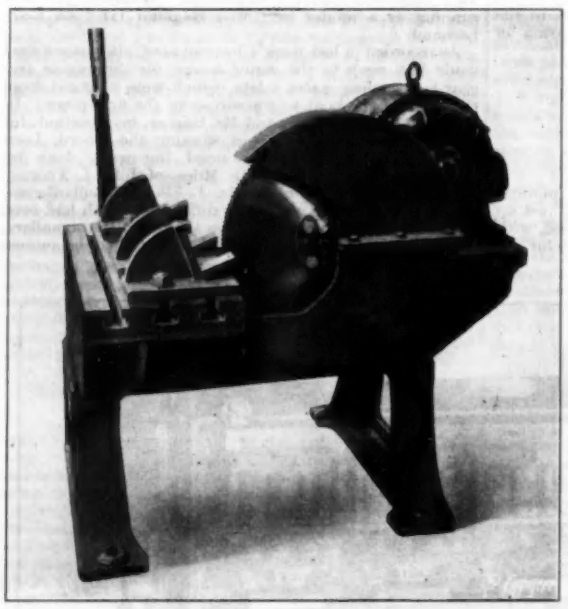
The automatic equipment for short circuiting the slip rings consists of a cam and worm gear mechanism driven by a small induction motor, and limit switches are provided on the operating gear to interrupt the supply of current to the motor at the end of the travel, whilst leaving the connections available for the reverse motion. To prevent grooving of the commutator and slip rings an automatic end play device is fitted at one end of each machine, whilst to guard against excessive speed a centrifugal speed limiting device is fitted at the other end and is electrically connected to the main circuit breaker. Each set occupies a space of 18ft. 0in. by 8ft. 7in. and is 9ft. high.

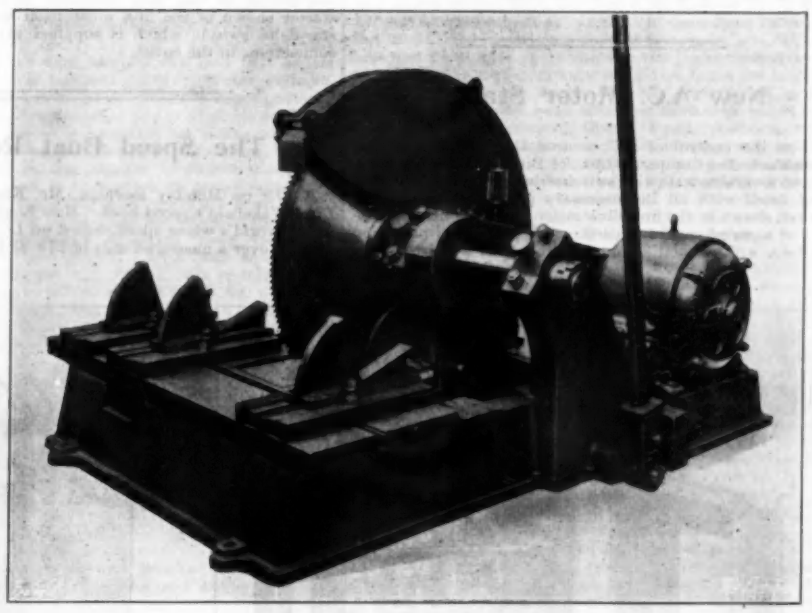
Two Hot Sawing Machines.

THE accompanying engravings show two hot sawing machines manufactured by S. Russell and Sons, Ltd., of Leicester, one with a 36in. diameter blade, the other with an 18in. diameter blade. The 36in. machine is suitable for use in small forges, rolling mills, and stamping shops. It has a table measuring 4ft. 6in. long by 1ft. 4in. wide. This table is provided with adjustable "vee" rests for holding the material during the sawing process, and is operated by a hand lever at the side of the machine. The machine can be fitted with a belt drive, but in the case of a motor-driven machine, such as is illustrated, the drive from the motor to the saw spindle is by an inverted tooth chain, which is totally enclosed and efficiently lubricated. For driving purposes a 15 H.P. motor is required. The saw spindle is mounted in gun-metal bearings, adjustment being provided to take up any wear. The saw is guarded to prevent accidents. A water trough is formed in the bed of the machine. There is also a smaller machine with a 30in. diameter blade made on similar lines to the one described above. This smaller machine has a maximum cutting capacity of 5in. diameter. The smallest machine of the series, illustrated in the left-hand engraving, has an 18in. diameter blade, and a maximum cutting capacity of 2¾in. diameter. The bed of the machine is mounted on pedestals and serves as a work table and slide. A 5 H.P. driving motor is placed upon a saddle, which forms a complete moving unit. The operation of the machine is by a hand lever placed at the side.



2500-kW MOTOR CONVERTERS AT ARLINGTON-ROAD SUB-STATION, ST. PANCRAS





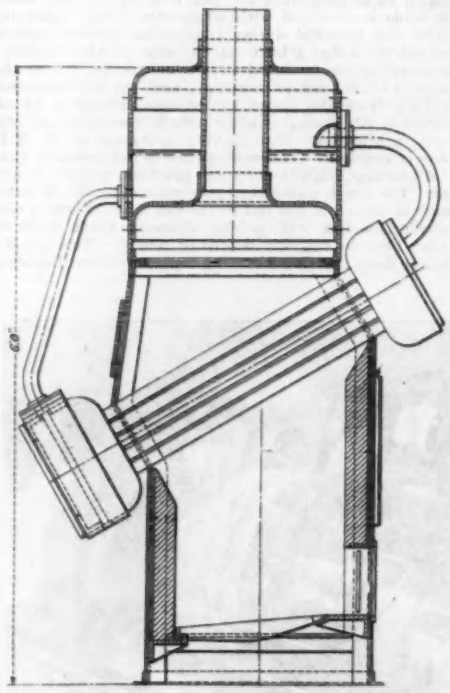
18-INCH AND 36-INCH HOT SAWING MACHINES

A Water-tube Vertical Boiler.

A BOILER of rather unusual characteristics is being manufactured by Fraser and Fraser, Ltd., of Bromley-by-Bow, and is illustrated by the drawing overleaf. It is, it will be seen, of what might be generally described as of the vertical type, but it includes a number of inclined water tubes. These tubes provide, in fact, the major part of the heating surface.

Little description is necessary, in view of the drawing, as it is plain that the boiler comprises a combustion space, a group of water tubes for steam raising, and a

combined water and steam drum. It will be noticed that the combustion space is lined with fire-brick, with the object of reducing smoke when bituminous fuel is being burned, and that the headers of the water tubes are readily accessible, through being entirely outside the casing. The three parts of the boiler—that is to say, the furnace, the water tubes and the drum—are easily separated, so that it is very convenient for transport, while the



WATER-TUBE VERTICAL BOILER

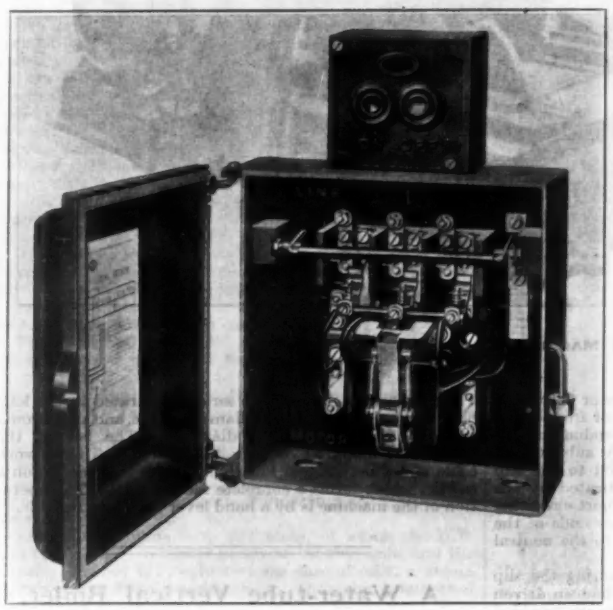
fireplace can be readily adapted to most local fuels where coal is not available.

These boilers, it is claimed, will produce from 6 lb. to 11 lb. of steam per hour per square foot of heating surface and work with a thermal efficiency of about 70 per cent. They are made in a number of sizes, ranging in output from 185 lb. up to 5250 lb. per hour, and are capable of raising steam from cold in fifteen minutes.

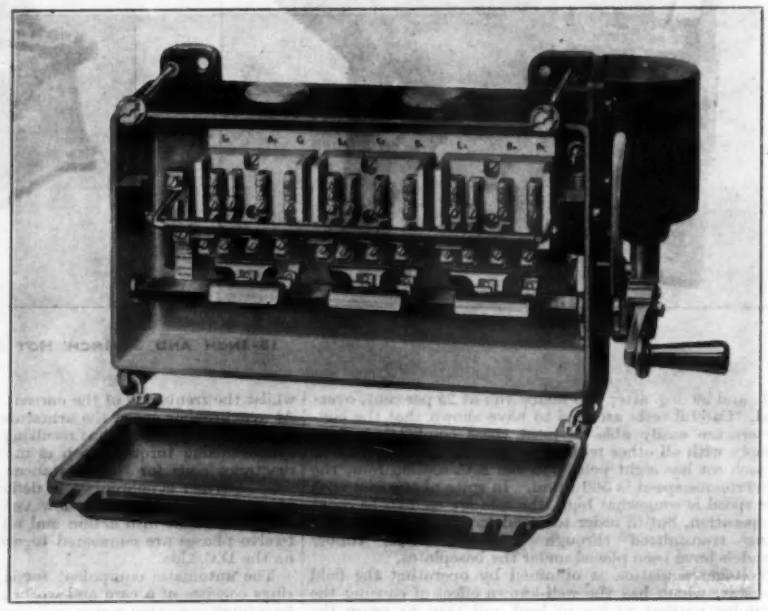
New A.C. Motor Starters.

FOR the control of A.C. motors the Midland Electric Manufacturing Company, Ltd., of Birmingham, has introduced several new starting switches designed on simple lines, and fitted with all the necessary protective gear. The switch shown in the first illustration is for the direct starting of squirrel cage and certain other types of induction motors, with capacities ranging from ½ to 5 horse-power. Overload trips are provided on all three phases, and there is also a no-volt release. The starter is enclosed in a stove-enamelled case, which is drilled at the top and bottom for the reception of ¾in. conduit, for the supply leads and those running to the motor. As sent out by the makers, the press-button control unit is fixed at the top of the switch, as shown in the illustration, but it may be attached to the bottom of the starter or, if desired, in any position close to or remote from the starter or motor. Spare push-button units can be supplied for additional control points. The switch contacts have a silver face, and they can readily be replaced by new contacts. A load indicator is incorporated in these starters, and the trips operate at a maximum overload of approximately 20 to 30 per cent. above the current setting indicated on the scale. The time lag varies inversely with the overload from about 15 sec. with 100 per cent. overload to 5 min. or 15 min. with 25 per cent. overload, according to the current rating.

The switch shown in the second illustration is for starting squirrel cage and certain other types of induction motors, up to 10 horse-power in accordance with the star-delta method. Like the first switch, it is fitted with overload trips on all three phases, and it has a no-voltage release. It is impossible for the operator to manipulate the switch in the incorrect sequence. The exterior of the cast iron case is enamelled jet black, whilst the interior is coated with white insulating enamel. Holes in the top of the case permit of the entrance of 1¼in. conduit, which is fixed in position by nuts. The cover is fitted with a gasket, which makes the switch waterproof and suitable for use in exposed positions. A glass window may be provided in the front of the cover to enable the movements of the switch contacts to be observed, or, alternatively, a solid cover may be provided, as shown. A trip lever serves for releasing the switch and stopping the motor by hand, but, if necessary, a remote controlled trip can be arranged for by extending the no-volt circuit from the switch to any desired position. Reversible round brass tips are fitted on the fixed contacts, so that new surfaces can be presented to the moving copper contacts when necessary. The description of the load indicator fitted to the direct starter shown in the first illustration also applies to the star-delta switch, which is supplied with a diagram of connections in the cover.



DIRECT STARTING SWITCH



STAR-DELTA STARTING SWITCH

The Speed Boat Record.

EARLY on Monday morning, Mr. Kaye Don, piloting Lord Wakefield's speed boat "Miss England III.," set up a new world's water speed record on Loch Lomond, with a speed over a measured mile of 119·81 miles an hour. A view of the boat on the course on Loch Lomond is reproduced in the accompanying engraving. The previous record was held by the American, Commodore Gar Wood, with a speed of 111·65 miles an hour. In relation to her weight and size, "Miss England" is the most powerful craft ever built. After her trials at Lake Garda, she was equipped with two new Rolls-Royce engines, exactly similar to those fitted to the Schneider Trophy seaplane which set up the world's air speed record last year. These engines are a modified and improved version of the R type aero-engine first evolved for the 1929 Schneider Trophy contests, this latter engine being in its turn developed from the 825 H.P. "Buzzard" engine. The two engines, which have a bore and stroke of 6in. by 6·6in., have twelve cylinders, and are supercharged, each supercharger rotor having a speed of 25,600 r.p.m. At a crank shaft speed of 3200 r.p.m., the power output of each of the two engines is 2200 B.H.P., giving a total of 4400 B.H.P. The weight of each engine is only 1630 lb., so that the power weight ratio is roughly 12 oz. per brake horse-power, compared with 9 lb. to 10 lb. in an ordinary car. At full throttle, fuel consumption is at the rate of over 300 gallons an hour, or about 5 gallons a minute.

"Miss England III." carries 250 gallons, or sufficient for a run of something over 40 min. The drive from each engine is taken forward to separate gear-boxes in the bow,

MISS ENGLAND III. ON LOCH LOMOND

and thence downwards and sternwards to twin propellers rotating at 7500 r.p.m. The engines are started up by compressed air. Cooling of the gear-boxes and the transmission, as well as the engines, is by water, the temperature being recorded on dials on the dashboard. The designers and constructors of "Miss England III." were John I. Thornycroft and Co., Ltd. In this connection it may be of interest to our readers to refer to our issue of July 15th, 1910, in which we described under the heading of "Skimming Boats," the late Sir John Thornycroft's "Miranda IV.," which was the first boat worthy to be called a "speed" boat. She was 26ft. long with a 6ft. beam, and displaced about 1 ton. Her engines were of the eight-cylinder type, developing between 100 and 120 H.P. The "Zigerella," a sister ship of the "Miranda IV.," was running as a tender to "Miss England III." on Loch Lomond.

As recorded in last week's Journal note, alterations were made last week to the water scoops for the engine and gear-box cooling water inlets, which were changed from the stern of the boat to a position on the first plane. In thanking Mr. Kaye Don and Mr. Garner, his assistant, for the part they had played in winning the record, Lord Wakefield particularly mentioned the work done by Commander Leyland and Mr. Miles, of John I. Thornycroft and Co., Ltd., and by Mr. J. Ellor, of Rolls-Royce, Ltd., in overcoming the various difficulties which had been met with. He also expressed his thanks to the signallers, timekeepers and others who had contributed to the success of the event, not forgetting Sir Iain Colquhoun, on whose estate at Rossdhu the boat was housed.

IN Pretoria the charge for electricity for water heating between the hours of 10 p.m. and 8 a.m. is ½d. per unit.

Census of Production, 1930.

THE following table summarises the returns received from the mechanical engineering trades in the Censuses of Production taken in 1924 and 1930. Reference to this table is made in our leading article "Impressions and Statistics."

Group.	Gross output.	Cost of materials used and value of work given out.	Net output.	Average number of persons employed.	Net output per person employed.	Mechanical power available.
	£'000	£'000	£'000	No.	£	Th. H.P.
Agricultural machinery—						
1930	3,203	1,192	2,011	11,013	183	13·3
1924	3,249	1,323	1,926	10,400	185	10·8
Locomotives, engines, boilers and boiler-house plant—						
1930	19,484	8,373	11,111	52,681	211	165·4
1924	29,505	14,165	15,340	79,297	193	182·4
Machine tools—						
1930	6,139	2,867	3,272	18,356	178	47·6
1924	2,958	1,116	1,842	9,910	186	27·5
Marine machinery—						
1930	23,354	12,408	10,946	57,527	190	204·8
1924	21,015	11,000	10,015	61,291	164	252·7
Printing and bookbinding machinery—						
1930	3,627	769	2,858	10,181	281	14·5
1924	2,383	657	1,726	7,423	233	10·5
Textile machinery—						
1930	11,833	4,548	7,285	48,097	151	87·3
1924	18,570	7,411	11,159	60,303	185	81·0
All other engineering—						
1930	90,960	40,230	50,730	231,935	219	471·2
1924	74,687	32,332	42,355	198,665	213	329·2
Total 1930	158,600	70,387	88,213	429,790	205	1,004·1
Total 1924	152,367	68,004	84,363	427,289	197	894·1

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

General Conditions.

LAST week's midsummer quarterly meeting of the Midland iron trade provided little additional business for producers in this area, but gave every evidence of a quiet current quarter. As recorded in my report of the meeting, prospects in several directions were considered to be brighter, but it was revealed that industrialists were disinclined to travel ahead of known requirements, and although they estimated that their probable consumption of material would gradually increase, they were content, at any rate for the time being, to buy in small parcels. Substantial contracts were very few, and the order books of Midland iron and steelmasters are but little heavier as a result of the quarterly gathering. The current summer quarter is notably a quiet one industrially, but there are those who claim to foresee for it more than the recent average of work. The majority of industrialists here cannot see far ahead at present, and although they remain hopeful they are still anxious regarding the development and extension of trade. The past week has brought no notable change to the position in this area. The general demand for iron and steel has been of a limited character and transactions have been put through at recent selling rates. The weekly market was only moderately attended and sellers were in the majority. There is a surplus of production despite the fact that output is being restricted in most, if not all, branches. Probably the most active department at date is the electrical trade. Firms producing plant for electrical development schemes are actively engaged, as are the wireless manufacturers. Makers of torches, batteries, and the like are moderately engaged and are expecting heavy calls in the very near future. A moderate tone prevails in the hollowware industry in the Black Country.

Raw Iron.

Midland blast-furnaces continue to produce at recent rates, but a portion of the output is going into stock. Foundrymen in this area are taking moderate tonnages, those associated with the light castings trade being the most active. A wide range of such castings, chiefly for the home trade, are being turned out weekly. The heavy engineering foundries have not improved their position. Forges in the Midlands are but poorly employed and sales of forge pig are few. In the quarter just ended, pig iron producers have been able to keep furnaces at work, although they have not sold anything like the total output, and they are hopeful of being able to maintain the present rate of production. Contracts which were entered into early last quarter are not as yet completed, specifications against them having been on the small side. Some contracts which have expired have not been renewed, users being content for the time being to buy as required on the open market. Values of raw iron are unchanged, Derbyshire No. 3 foundry selling at £3 6s. per ton, delivered Black Country stations; Northamptonshire No. 3 foundry £3 2s. 6d.; North Staffordshire No. 3, £3 6s., while forge grades are 5s. per ton less in each case.

Finished Iron.

Finished iron business continues disappointing, being of a hand-to-mouth character. There is no disposition on the part of consumers to order in large quantities, or on forward account. Plant is employed at something less than 50 per cent. capacity in most branches of the industry. Selling prices are firmly maintained for marked bars and strip, but Crown iron makers have been obliged to make concessions so as to keep orders in the area. Competition for all the available business is very keen. Belgian makers of No. 3 iron still seek business amongst the Black Country nut and bolt firms. Most of these firms at the moment are not in need of fresh supplies, having considerable stocks to draw upon. Staffordshire marked bars sold this week at £12 per ton at makers' works, Crown bars at something above £9 delivered. Fencing bars were quoted £7 15s., and nut and bolt bars up to £8. Wrought iron tube strip is firm at £10 10s. per ton delivered.

Steel.

The position of the heavy steel trades shows no improvement. Midland structural engineers are having a struggle to keep their yards open and the consumption of steel continues light. Neither is there any demand for bridge work, except a few small contracts. Mills rolling constructional steel are accordingly working only intermittently. Dullness in the general engineering trades likewise adversely affects the production of steel. Selling prices of sections, joists and plates under the scale fixed by the Steel Manufacturers' Association are unchanged, quotations being the same as they have been for the past eighteen months. In the half-products department the development of business is held up by the large stocks in users' hands. The billet makers' price scheme introduced some time ago as an inducement to consumers to buy from native makers has not yet had a fair test, but steelmasters anticipate increased business as foreign stocks diminish. Very few orders are going to the Continent from this district at date, despite the fact that sellers offer supplies at prices below those of the home products. It is reported that the trend of events on the Continent points to an early abandonment of the attempt to retain the markets and defeat competition by selling at prices that in themselves are unremunerative. There are no very definite signs in this market of such a change of policy. Foreign steel is coming in at prices very little higher than those which prevailed when we were on the gold standard and the British market was free to general exploitation. Staffordshire re-rollers have made no alteration to their quotations. All-British small steel bars are £7 upwards per ton. Small bars re-rolled from Continental raw material are quoted £6 7s. 6d. upwards. Mild steel billets range from £4 17s. 6d. to £5 7s. 6d., and sheet bars from £5 to £5 5s. Staffordshire hoops remain firm at £9 10s. delivered.

Galvanised Sheets.

The galvanised sheet trade in this area is much as it was a week ago. Demand is spasmodic and not up to normal. Recent inquiries on overseas account are taking a long time to materialise. Selling prices are unchanged, being on the basis of £9 5s. to £9 7s. 6d. for galvanised corrugated sheets of 24 gauge.

Production.

The position in the raw iron industry not only in this district, but in the Kingdom as a whole, is clearly shown in the statistics of activity and production for the month of June. Blast-furnaces have been carrying on much as during the previous month, and there were at the end of the month sixty-nine furnaces in blast, the same number as at the end of the previous period. The production of pig iron in June amounted to 311,400 tons, compared with 315,300 tons in May, and 323,800 tons in June, 1931. Production included 75,700 tons of hematite, 130,100 tons of basic, 85,500 tons of foundry, and 13,200 tons of forge pig iron. The output of steel ingots and castings in June amounted to 459,300 tons, compared with 416,900 tons in May and 428,900 tons in June, 1931.

Motor Engineering Transfer.

Automobile engineers will be interested to learn that the business of the Star Motor Company, Ltd., which was carried on under various names in Wolverhampton for forty-two years, has now been transferred to Hall Green, Birmingham, it having been acquired by McKenzie and Denley, Ltd. It will still be carried on under the title of the Star Motor Company. I am informed that the company has an excellent organisation for the continued manufacturing of the Star products, including the production of spare parts to the original Star specifications and drawings. Previously known as the Star Engineering Company, it was the oldest firm of motor car manufacturers in the town, and one of the oldest in the world. The first Star car was built in 1898.

Refrigerator Manufacture.

An old-established Wolverhampton firm of enamellers, Orme, Evans and Co., Ltd., has embarked upon the manufacture of refrigerators, thus bringing a new industry to this district. Hitherto, the home of the refrigerator industry has been in America. Messrs. Orme, Evans have evolved an apparatus which is claimed to be new in principle of operation and more efficient than any refrigerator yet produced. The compressor is of a special rotary type, which runs in oil and entirely eliminates pistons, connecting-rods, piston rings, and springs. A patented double helix evaporator is incorporated, which is so designed that de-frosting is unnecessary. The equipment has a vitreous enamel cabinet, which is fitted with shelves designed to give the maximum of service. The refrigerator is an entirely Wolverhampton production, from the design to the finished article.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Rise in Textile Machinery Exports.

THE improvement in textile machinery exports compared with a year ago, which has been noted in previous months of the present year, continued during June, in which month shipments represented not only a substantial increase, both in quantity and value over those in the corresponding period of 1931, but were also above the average for the January–May period of this year. The total exports of this class during the month under review amounted to 5560 tons and £494,442, against 3895 tons and £389,173 a year ago and 8007 tons and £754,926 in June, 1930, last month's shipments including 3795 tons of spinning and twisting machinery, valued at £339,098, and 1233 tons of weaving machinery, valued at £93,669. Exports to British India were on a much heavier scale than they were a year ago, and increases of varying extent have also occurred in the case of Germany, the Netherlands, Japan, and Australia. India occupied first place with takings valued at £205,199; followed by China, with £35,315; Japan, £29,810; South America, £28,071; the Netherlands, £17,257; Germany, £15,571; France, £14,865; Australia, £13,181; and the United States, £10,109; aggregate shipments to "other European countries" reaching a value of £83,958 compared with £62,246 in June of last year.

A Satisfactory Half-year.

Although the exports during the first six months of the year are appreciably below what they were in the January–June period of 1930, it is satisfactory to be able to record that they represent a substantial improvement compared with the corresponding half of last year. In the six months ended June last, the total exports amounted to 33,413 tons, valued at £2,899,042,against 25,730 tons and £2,587,210 in the first half of last year, and 50,182 tons and £4,819,816 in 1930. For the improvement over a year ago the bigger exports to British India are largely responsible, although Japan also has contributed in no small measure, whilst lesser increases have occurred in the case of the Netherlands, China, South America, and Australia. On the other hand, noteworthy among the declines, have been a contraction in shipments to Russia, and also in exports to France, the latter owing to tariff operations.

The Passing of the Steam Users' Association.

Regret over a much wider area than Manchester or Lancashire will be felt at the passing, as a separate entity, of the Manchester Steam Users' Association after an existence extending over nearly eighty years. It was stated towards the end of last week that the interests of the Association had been merged with those of the British Engine, Boiler and Electrical Insurance Company, Ltd., which would take over its liabilities, staff, and pension arrangements. The Association was formed by Mr. (later Sir) William Fairbairn in September, 1854, under the title of "The Association for the Prevention of Steam Boiler Explosions," and its first chief inspector was the late Mr. R. B. Longridge. Mr. J. T. Browne, of Manchester Collieries, Ltd., who succeeded Mr. Harold Lee as President of the Association, at the annual meeting a few months ago referred to the adverse effect on the position of the Association of the gradual growth of the use of other forms of motive power in place of steam, and of the disuse of boilers, which was going on all over the country. He added that proposals to improve the position, always having regard to the limits imposed upon them by the unique character of the Association's constitution, were receiving the careful consideration of the Committee.

A Labour Dispute Settled.

After lasting for more than three months, a settlement has been reached in the labour dispute in the Atherton nut and bolt industry, the employees having accepted the reduced scale of wages which were at first offered by the employers.

Order for Coke Ovens and By-product Plant.

An order for coke ovens, by-product plant, and coal and coke handling equipment, said to be of the value of £150,000, for the Manvers Main Collieries, Wath-on-Dearne, South Yorkshire, has been secured by Simon-Carves, Ltd., engineers, of Cheadle Heath, near Mancheste r

Non-ferrous Metals.

Whilst weakness on rather a noticeable scale has developed in all other sections of the non-ferrous metals market during the past week, tin has maintained a firm front. Speculative buying of tin has been a feature of market operations, and this fact, coupled with a slight improvement in the statistical position of the metal,

made for somewhat higher prices. There has been some slight reaction from the top values, but at the close tin is almost exactly on the levels that were current a week ago. In the case of copper, buying interest from consumers in this country, as well as in the United States and on the Continent, has been subdued, and with no apparent reduction in available supplies, prices have weakened appreciably to the extent of rather more than £1 per ton compared with a week ago. Quiet trading conditions have also obtained in the lead market, and a further depressing influence in this section has been profit-taking operations on an important scale after the recent advance, the loss on balance amounting to about 15s. per ton. Following upon the slight reaction of the previous week, spelter has again lost ground to the extent of about 5s. to 7s. 6d. per ton, with the demand on a quiet scale.

Iron and Steel.

The foundry iron position in Lancashire continues to be dominated to no small extent by the superabundance of good quality scrap which is offered at approximately £1 10s. per ton below the ruling rates for Midland brands of pig iron. Buying of the latter is restricted in consequence, although quotations are held on the basis of 67s. per ton delivered Manchester or equal for Staffordshire, Derbyshire, and Cleveland No. 3; 65s. 6d. for Northamptonshire; 62s. for Derbyshire forge; about 84s. 6d. for Scottish foundry; 81s. for West Coast hematite; and from about 67s. to 77s. per ton according to quality for Indian pig iron. The bar iron trade is quiet at £9 15s. per ton for Lancashire Crown bars, and £10 5s. for best quality material. The demand for structural steel locally is still very quiet, but during the last few days rather more interest has been displayed in general plates and bars, and also in special alloy steels. Values are reasonably steady all round, with boiler plates at from £8 10s. to £8 12s. 6d. per ton; small re-rolled bars at £6 15s. to £7; joists at £8 15s.; sections at £8 7s. 6d.; ship and tank plates at £8 17s. 6d.; and large diameter bars at £9 7s. 6d. Trade in imported materials is virtually at a standstill, and remarkably low prices are being indicated in respect of most classes of iron and steel.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron market remains quiet, and, if anything, there is a tendency for deliveries to be smaller for the time being. This may mean that customers are reducing their orders in view of stoppages for the holidays. Much of the iron at Barrow has been required on steel account, but production of both iron and steel will be suspended during the holidays, and this temporary stoppage will enable certain repairs to the plant to be made. The Continental trade is still very thin, and there is very little business with America, and any shipments there may be are small and are not going direct. The iron ore trade is quiet, and may be quieter in the early future, owing to the restricted output of iron. Foreign ore is in quiet demand. In the steel market few orders are available. The market is dull and overseas inquiries are limited.

Shipbuilding.

Barrow was cheered last week by a statement made by Commander Craven, the managing director of Vickers-Armstrongs, that many were hoping to hear good news at Barrow, and if he had not very good news for them in the next two or three weeks he would be very disappointed. It is too early to hint at what Commander Craven referred to, but it is known that the firm was a short time ago very actively engaged on designs and estimates.

SHEFFIELD.

(From our own Correspondent.)

The General Position.

No evidence is yet to be found of any forward buying movement such as would strengthen the state of the local steel industries, and the position generally is without change and without striking feature. The placing of new business is also being affected by holiday influences. The open-hearth steel furnaces are continuing to operate at recent levels, but orders and inquiries, so far from showing expansion, display a shrinking tendency. On the heavy manufacturing side the forging of hollow-rolled drums is a good line, but the railway steel departments are still very slack. The demands of the automobile builders continue to provide a large amount of employment in the production of stampings, pressings, and special steel. The rolling mills are quiet, and there is not much activity at the crucible plants. The position of stainless, heat-resisting, and acid-resisting steels continues healthy, and there is also fairly brisk business in best quality wires and steel strip.

Better News from Lincolnshire.

Comparatively favourable reports come from the steel works in North Lincolnshire, several of which are better employed than they were at any time last year. With its natural advantages for cheap production, together with up-to-date equipment and management, the district is obtaining a good share of what work is available. At Lysaghts' works, seven open-hearth furnaces out of eight are in commission, and the mills are running better than at any time in 1931. The order for 3000 tons of plate for Russia, recently placed with the Appleby works, has now been completed, and the material despatched, but the four large open-hearth furnaces are still running continuously.

The Tool Trades.

There is a fair demand for engineers' tools and some other products in this branch, but the conditions of the trade are very mixed. A few firms are doing well, and one factory is being enlarged, but in many cases order books are unsatisfactory, and there are many complaints of falling trade, especially with the home market. The season for the sale of garden tools was a poor one, owing to the long spell of cold and wet weather which occurred just at the period when amateur gardeners usually renew their tools and implements, and the improvement in the weather came too late to be of much value. There has also been a restricted sale of tools to farmers, whose circumstances have compelled them to economise. The saw and file trades show no progress, and are not satisfactorily placed, while foreign trade in plantation tools continues very quiet. A recent addition to the tool trades of this country is the manufacture of very small files which are used mainly by jewellers and watchmakers. Formerly, most of these articles were obtained from Switzerland, but now firms in Sheffield and Lancashire are producing them successfully, and Sheffield files are actually being sold to the Swiss watchmakers. An application has been made to the Tariff Advisory Committee for an increased duty on imported precision files of this description, and also on manicure files.

Economy and Effort.

Drastic economies are being found necessary to meet the present position in the steel trade, but at the same time every effort is being made to capture trade and to prepare for better times. An instance of this is afforded by the English Steel Corporation, which has one of its most important establishments (Vickers' works) at Sheffield. There has recently been a number of dismissals of members of the staff, and the matter has received the attention of the Members of Parliament for the city, who have had an interview with Sir Herbert Lawrence (chairman) and other directors of Vickers, Ltd. As a result, a statement has been published wherein the Sheffield Members express their conviction that the need for dispensing with a number of the staff has no connection with the formation of the Sheffield committee set up to bring into operation a measure of reorganisation in the industry. "Unfortunately," the statement proceeds, "the depression in the iron and steel trade has increased in severity during the last few months, and these economies are essential to help reduce overhead charges sufficiently to enable the industry to compete in the world markets. We (the Sheffield Members) are informed that the business obtained by the English Steel Corporation suffered a reduction of no less than 75 per cent. during the period 1929–32. The company has arranged for an expenditure of many hundreds of thousands of pounds in modernising its plants, and this should be sufficient indication that it is determined to bring a fair share of trade to Sheffield." Sir Herbert Lawrence has promised to make a further statement to the Members in the near future, and this will be published.

A South American Order.

An interesting order has just been carried out by Thos. W. Ward, Ltd., which has supplied 3000 Albion steel wheelbarrows to South America. For convenience of carriage the bodies were nested in twelves, the frames and wheels being packed separately in compact bundles. The whole consignment weighed nearly 80 tons. The barrows were constructed of steel tube framing, the bodies being pressed from single steel sheets. The barrows can be put together quite easily by unskilled labour on arrival at their destination, with the aid of nothing more than a spanner. They were despatched within fourteen days of the receipt of the order.

New Coke Oven Plant.

A scheme of reconstruction in connection with the coking and by-product plant is to be carried out at Manvers Main Collieries, Wath-on-Dearne, and the directors have placed an order with Simon-Carves, Ltd., Cheadle Heath, near Manchester, for a battery of the latest type coke ovens, complete with the necessary machinery, and up-to-date by-product plant, coal and coke-handling equipment, and coke-screening plant. There will be thirty twin-flued silica-lined regenerative ovens, with a carbonising capacity of 500 tons of dry coal per day. The coal-handling plant will comprise electrically-operated wagon tipplers, coal conveyors, crushers, and a reinforced concrete service bunker, having a capacity of 2000 tons of coal. A coke-quenching tower will be provided and coke will be handled from a wharf by a conveyor which will deliver to the primary screens, where furnace coke will be screened out and loaded to wagons. A secondary conveyor and screen house, with storage bunkers, will be provided for domestic coke. The by-product installation will include gas condensers, ammonia and benzole scrubbers, with plant for the recovery and rectification of benzole, and an electrostatic tar precipitator.

A Bridge Construction Feat.

An important job in bridge construction, and the biggest ever attempted in Britain, was carried out in the early hours of Sunday at Pictor, near Buxton, where the river Wye and the main road to Derby, running side by side, are crossed by the railway line to Sheffield and Derby. A wrought iron bridge, built eighty years ago, was replaced by a double-skew span bridge of all-British steel, 80ft. long and weighing 700 tons, to meet the requirements of modern heavy traffic. The new bridge was constructed on trestles erected alongside the old structure. The demolition of the old bridge began at half-past two in the morning, and at seven o'clock the new bridge was rolled along the trestles on carriages to fill the gap. Forty minutes later it was being bolted into position. The bridge is part of a £33,000 contract which is being carried out by Dorman, Long and Co., and under which three more bridges are to be completed by October. Another interesting bridge item is that Thomas Broadbent and Sons, Ltd., Huddersfield, are to make the electrical operating machinery for the two approach bridges over the Yangtse River, which are to be built by Dorman, Long and Co.

Cutlery and Plate.

There is no change in the condition of the cutlery and plate trades, which continues, in the main, unsatisfactory. The cutlery export figures for June showed a moderate increase upon the previous month and also upon the corresponding month of last year. The total for the six months is £59,000 up on last year. It is still, however, far below the figure for 1930. There has been a remarkable expansion in the trade in safety razors, which accounts for the whole of the increase. In the past six months this section represented more than half of the total cutlery exports. There was an increase in the quantities of scissors and knives exported, but a fall in values, comparing the first half of this year with that of last year. The value of cutlery imported in June was much the same as in May. In the six months the total under this head has declined from £416,393 to £64,248. Our exports of imported cutlery have fallen greatly. The value in June was only £1100, whereas in June last year it was nearly £90,000. The six months' fall in this trade has been from £123,672 to £21,918. The new cutlery works established in Sheffield by a Solingen firm are now operating.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

No marked expansion has yet taken place in the Cleveland pig iron trade. The fact is that the quietest period of the year from a trading point of view has been entered upon, and it is not expected that there will be any real buying movement until the end of August. With the Scottish holidays now in full swing, one important outlet for the disposal of Cleveland iron is temporarily closed, and demand in other directions is falling off under holiday influences. Stocks, consequently, show a tendency to increase, and makers are very keen to negotiate contracts. They are unable, however, to offer further concessions, and consumers are indisposed to commit themselves at present prices. To home consumers No. 1 Cleveland iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s. Special prices are still quoted for Scottish trade.

Hematite Pig Iron.

There is little change in the East Coast hematite pig iron trade, which continues steady, and with most of the demand coming from home customers This steady trade over the past few weeks has had the result of bringing stocks down, although some of the works still have large tonnages on hand. The local steel works are still taking a fair tonnage of iron, and this fact is helping in the general clearance. Although makers ask up to 62s. 6d. for mixed numbers, buyers state that a shilling below that figure is not refused for a good order, so that the market value is little more than 3s. above the fixed price of No 3 Cleveland iron, whereas the normal difference was quite 8s. No. 1 quality is at a premium of 6d. per ton.

Ironmaking Materials.

Foreign ore is in moderate demand, and is being imported in restricted tonnage. Best Rubio is offered at 15s. c.i.f. Tees. Durham blast-furnace coke sellers experience difficulty in realising 15s. 6d. for good average qualities delivered to the works in this district.

Manufactured Iron and Steel.

The tone of the manufactured iron and steel trade shows a slight improvement. Conditions are gradually changing for the better, and the opinion prevails that a period of good trade will be entered upon in the autumn months. Foreign competition is declining, especially in semi-finished materials. Departments producing shipbuilding material are short of work, but it is reported that shipbuilders have had a little more estimating work to do. Manufacturers of railway material are only moderately employed. Branches engaged on the output of constructional steel keep very busy, however, and report that orders are coming steadily forward. Prices are firmly maintained.

Big Repair Order.

R. W. Hawthorn, Leslie and Co., Ltd., have secured one of the biggest ship-repair and reconditioning contracts which have come to the Tyne in recent years. Against very keen competition they have obtained the job of reconstructing the public rooms of the Shaw-Saville liner "Euripides," and also of effecting the conversion from coal-burning to oil-burning. The work will occupy about three months. The "Euripides" is a liner of 14,947 gross tons, and is 500ft. in length.

The Coal Trade.

The Northern coal trade has scarcely changed from last week. Inquiries from abroad are on a small scale, and the home demand is little improved, although domestic needs increased as a result of the cooler weather. Many collieries have had idle days of late, and there are prospects of more before the month ends. In the matter of dullness, all classes of coal are alike. Some descriptions of large steams may be a little better off for trade than others, but in the main there is a limited inquiry. Best Northumberland steams are freely offered at 13s. 6d., smalls being steady at 8s. 6d. and rather in short supply owing to the moderate output. Prime Wear steam qualities, large or small, are in slow demand, but best screened are in abundant supply at 15s. to 15s. 1½d., and prime smalls are at 11s. to 11s. 1½d. Bunkers are the only fuel that are able to show steadiness. In the six months ended June 30th the bunkers shipped from the Tyne totalled 921,283 tons, compared with 921,753 tons in the first half of last year, a decrease of 470 tons. Business passing in bunkers is far below the ordinary demands at this period of the year. Best qualities are plentiful at 13s. 6d. to 13s. 9d., and good sorts are at 13s. to 13s. 3d. The Bergen Gasworks have again come to Durham County for their winter supplies. They have negotiated for 30,000 tons of gas nuts—20,000 tons from one colliery and 10,000 tons from

another. The price has not been disclosed, but it is on a f.o.b. basis and said to be at current values. This undertaking invariably buys sized coal. The delivery is to be from now until next March. Best Durham gas coals are quoted at 14s. 6d., and second class at 13s. to 13s. 3d. Coking unscreened and small are difficult to sell at the fixed schedule of 12s. to 13s. 9d., according to individual brands.

Winter Coke Contracts.

A good quantity of patent and other cokes has been sold to Scandinavia for consumption over the winter, but the prices have been very low and buyers are more favourably circumstanced than for a long time past. There is keen competition for the business, as German and Belgian shippers offer cheaply over twelve months. Some Durham makers have completed contracts, and there is other trade to come on. With ordinary patent coke offered at 14s. for export, it is hard to see how there can be any profit to the producers. The home demand is very moderate. Gas cokes are fairly steady at 17s. to 17s. 6d. Makers' output is somewhat in excess of current requirements, but stocks are not showing any pronounced increase.

SCOTLAND.

(From our own Correspondent.)

"Fair" Holidays.

FROM now onwards until the first week or so in August markets will be more or less under the holiday influence. The West of Scotland and certain districts in the East of Scotland are already on vacation, and other districts will follow suit. In many instances the usual week has been extended to a fortnight, and it will largely depend on the accumulation of orders what kind of a restart will be made.

Steel and Iron.

Makers of steel and iron are hopeful that industry will benefit from inquiries recently in circulation, especially in respect to shipbuilding work. Steel sheets have been fairly well placed for some time now, but a better demand for heavy material would be most welcome. Galvanised sheets, too, could do with an increase in turnover, the inquiry from abroad being disappointingly slow, despite the low prices quoted. Prospects in steel tubes are not particularly bright, owing, in a measure, to tariff barriers abroad. Bar iron and re-rolled steel bar makers would have welcomed a revision of local tariff arrangements at the end of the first three months, as the duties in operation at present do not afford any relief in competition with Continental material. Prices are all unchanged, with re-rolled steel bars quoted £6 10s. home fixed and £6 7s. 6d. per ton export.

Pig Iron.

Improvement in the pig iron trade is slow. Six furnaces are in operation and supplies have been ample. Consignments continue to arrive in this district, 2600 tons from Calcutta and 500 tons from England having arrived last week.

Scrap.

The scrap market is easy, with cast iron at 45s. and heavy steel 35s. per ton.

Coal.

Treble nuts, especially in Fifeshire, were the strongest feature of the market last week. Best Fifeshire steams were comparatively strong, but almost all descriptions of round fuels were easily obtainable for prompt delivery at about recent prices. Aggregate shipments amounted to 219,701 tons, against 234,499 tons in the preceding week, and 169,117 tons in the same week last year.

Aurora Lamps, Ltd.

The firm known as Aurora Lamps, Ltd., has brought a new industry to the Clydeside. Until now all lamps manufactured in the United Kingdom were made in England. It has been pointed out, however, that Aurora lamps are not intended to compete with the English product, but rather to replace the foreign production, the importation of which has practically ceased since tariffs came into operation. The capacity of the factory at present is 750,000 lamps annually, but within the next few weeks a second unit of machinery will be installed and the output doubled.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

ALTHOUGH the conditions in the steam coal trade have been generally quiet of late, there are points of interest, and features both good and unsatisfactory. For instance, shipments last week from this Channel—that is, from the ports under the control of the Great Western Railway Company—totalled, taking steam and anthracite coals together, 466,955 tons, which compares with 404,780 tons for the previous week and with 333,241 tons for the corresponding period of last year. Last week's figures were, in fact, the best since the week ended January 23rd last, while incidentally it may be mentioned that as regards the patent fuel industry, it now turns out that, according to the Customs returns, exports of patent fuel for the month of June, viz., 86,960 tons, were the highest monthly total since March, 1930. The dock position this week is not what could be desired, as on Monday there were thirty-nine vacant loading berths at Newport, Cardiff, Penarth, and Barry, although on Tuesday the total was thirty-six and there were six vessels waiting at the deep-water docks at Cardiff. It can scracely be expected that the figures regarding shipments for this week will equal the total for last week, and although there is no real evidence of any rush for coals before the holidays, it is satisfactory to note that so far as anthracite coals are concerned, there is a very steady demand, and loading operations are well maintained. As regards business, while the current demand for steam coals cannot be described as at all active, several cargoes have been arranged of late for prompt shipment to Rio de Janeiro. The Lisbon tramways have contracted with a local exporting firm for 10,000 tons of sized coals, but the Swedish Navy order for 22,500 tons has, as was rather expected, been placed for Westphalian coals. The Irish situation is causing some apprehension in this district, as the imposition of an embargo on British coals by the Free State Government will mean the loss of considerable business which can ill be afforded in times like the present. During the past six months shipments from South Wales to Ireland have been approximately 200,000 tons. The position is being very closely watched, and shipments to Irish ports of British coals are in the circumstances being expedited to the utmost possible extent. Attention is also being turned by exporting firms to the possibility of doing business with Irish importers in German coals, assuming that a ban is placed on British coals. Tentative inquiries are already circulating on the Cardiff market regarding tonnage supplies to convey coals from Rotterdam to Dublin.

Back-to-Coal Movement.

The Lord Mayor of Cardiff has received from Mr. Baldwin, Lord President of the Council, his reply to the deputation from South Wales regarding the appointment of a Commission to inquire into the question of the extended utilisation of coal. It will be recalled that Mr. Baldwin received the deputation on behalf of the Prime Minister. Mr. Baldwin in his letter expresses his regret that he cannot give a favourable reply to the request of the deputation for the appointment of a Commission. The letter is being considered by the "Back-to-Coal" Executive Committee, after which it is the intention that a full report shall be issued.

Steel and Tin-plate Items.

It is to be hoped that the trouble at the South Wales steel works of Richard Thomas and Co., Ltd., will before long be overcome, and that there will be no stoppage of work as is threatened at the present time. On Saturday last there was a meeting at Swansea of delegates representing more than 6000 men, when a resolution was passed calling upon the company to withdraw the notices which have been tendered to 600 men employed at the South Wales Steel Works, Llanelly, so as to enable negotiations to proceed, failing which the resolution declared that the company must accept responsibility for the stoppage that will ensue. According to the men's leaders, they are prepared to carry on with the negotiations over twenty-seven proposals submitted to them. Three of these proposals have already been satisfactorily disposed of, and there has been no breaking off of negotiations so far as the workers are concerned. So far as the Richard Thomas mills at Llanelly are concerned, work is to be resumed after a period of idleness of about three weeks. The dispute over the promotion of one of the workmen to take charge of a mill engine was satisfactorily settled last week. The Bryngwyn Sheet and Tin-plate Works, Gorseinon, where several hundred men are employed, restarted operations on Monday. The ascertainment for the past three months under the sliding-scale agreement shows that there will be no change in the rates of pay of men engaged in the Welsh tin-plate industry during the quarter ending November next.

Trade at South Wales Docks.

The G.W.R. Company's returns of trade at its docks cannot be considered at all satisfactory. The figures practically cover the first half of this year, and show that imports and exports totalled 13,294,647 tons, which compares with 14,285,173 tons for the corresponding period of 1931, and with 19,020,662 tons for the same period of 1930. Imports from January 1st to July 3rd were 1,705,861 tons, whereas for the corresponding period of 1931 the total was 2,024,198 tons. The falling off of oil and iron ore imports was particularly noticeable. Exports alone amounted to 11,588,786 tons, as compared with 12,260,976 tons for the first half of 1931, the decline of coal and coke shipments accounting for 610,214 tons. On the other hand, exports of tin-plates improved to the extent of 68,465 tons.

Coal Shipment Facilities.

For years past the question of speeding up the shipment of washed duff coal at local ports has presented a problem to all concerned. Especially in the winter time has this been the case, when the coal has not infrequently been frozen up, and it has taken round about half an hour to tip one wagon. Now, however, the Great Western Railway Company has installed at the Cardiff East Dock an appliance, the first of a number to be introduced at South Wales ports, which it is confidently expected will solve the problem, and enable the washed duff coal to be shipped with the speed of large coal. This appliance is the Norfolk Digger, which consists of a spade, or slice, attached to a strut which is capable of being mechanically extended or contracted, and is hinged to a fixed fulcrum, so that by a combination of these three movements the spade can command the whole of the contents of the wagon when in its tipping position. The spade is rotated on its fulcrum by means of a movable strut guided in the direction of its travel. The appliance is operated by hydraulic motors and spur wheel gear, the whole being self-contained and mounted on a movable carriage, travelling in guides attached to the front members of the hoist, so that it may be adjusted to suit the varying heights of the coal chute.

Current Business.

There has been very little fresh inquiry for prompt loading, and the tone of the steam coal market remains without change and is quiet. Dry qualities continue to be the steadiest section, especially sized descriptions, which are very difficult to stem for early shipment. Patent fuel is well placed for this side of the holidays, but the market for coke is still very inactive. Pitwood is not so plentiful, and, despite the fact that the demand is on a limited scale, the tone of this market shows a tendency to improvement.

British Standards Institution.

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

DOORS FOR INTERNAL AND EXTERNAL PURPOSES.

No. 459—1932. This specification covers morticed, dowelled and edged and braced doors for internal and external purposes, and has been prepared by the Building Division of the B.S.I. The Tables of Dimensions, which provide for twenty-seven British standard door sizes, including garage doors, are based on the principle of uniform height which, it is hoped, will eventually replace the existing practice of varying the height of the door with the width. The desirability of uniformity in height has been emphasised again and again in situations such as corridors or in large rooms where the present variations create a displeasing appearance.

At the commencement of the work this principle was strongly advocated by the Royal Institution of British Architects, and as the work progressed opinion in its favour has been widely expressed by all interested parties throughout the country, and it is significant and of interest to note that this practice is being adopted abroad.

It is realised, of course, that this change in something which has been trade practice for many centuries will take time to bring into effect, and to provide for the transitional period existing practice has been provided for as an alternative in the case of external doors, but it is hoped that it will be possible to delete this provision in future editions.

Apart from the dimensions the specification deals fully with materials and construction, but care has been taken not to restrict or hinder design.

Timber is provided for in clauses on general quality, knots, sapwood, and moisture content, an optional test for this latter and important property being given in an Appendix. Panels, both solid and of plywood, are specified.

The Committee has recognised, in drawing up the specification, the growing use of dowels in the manufacture of doors and the very satisfactory results this method of framing affords. Hence, the doors are required to be framed by joining and the members where they intersect by means of mortice and tenons or of dowels, as may be specified, in such a way as to secure rigidity and soundness throughout the frame.

The latter part of the specification provides for framed, ledged and braced doors, and ledged and braced door, concluding with a short specification of the finished product as delivered on the job.

GLOSSARY OF TERMS USED IN ILLUMINATION AND PHOTOMETRY.

No. 233—1932.—The British Standard Glossary of Terms used in Illumination and Photometry, which was issued in 1925, has just been revised to bring it up to date and in line with the decisions reached at the meetings of the International Commission on Illumination last year. The revision includes new definitions for Regular and Diffuse Reflection, Regular and Diffuse Reflection Factors, Regular and Diffuse Transmission and Regular and Diffuse Transmission Factors, Curve of Light Distribution, Polar Curve of Light Distribution, Solid of Light Distribution, Symmetrical and Asymmetrical Light Distribution. Photometric Surface, with its appropriate definition, has been substituted for Comparison Surface, and Uniformity Ratio and Diversity Ratio for Variation Factor and Variation Range. The definitions of Direct Lighting, Semi-direct Lighting, Semi-indirect Lighting and Indirect Lighting have been revised and a new term and definition, viz., General Lighting, added to this category.

The importance of the use of the same terms to mean one and the same things cannot be over-emphasised if confusion is to be avoided, and the use of this revised Glossary is therefore recommended to all whom it may concern.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

FOLLOWING a visit to this country of Mr. Howard Bristol, president of the Bristol Company, Waterbury, U.S.A., arrangements have been made with J. W. and C. J. Phillips, Ltd., who have represented the Bristol Company in England for forty-three years, for the manufacture of Bristol indicating, recording, and controlling instruments to be carried on at Messrs. Phillips' works at New Cross, London.

CONTRACTS.

G. D. PETERS AND CO., Ltd., have received an order from the Iraq Petroleum Company, Ltd., for fourteen Wilson "8" type portable petrol-driven electric arc welding plants for use on the construction of the Iraq pipe line.

H. TOLLEMACHE AND CO., Ltd., of Canada House, Norfolk-street, London, W.C. 2, have received a contract from British Insulated Cables, Ltd., for pulverised coal plant in connection with the new copper refinery now in course of construction at Prescot, Lancs.

JOHN FOWLER AND CO. (LEEDS), Ltd., have received orders for two oil-engined locomotives for a sugar estate in Natal. These engines are of 30 H.P. of the 0–4–0 type, and are intended for working on a 2ft. gauge track. A similar locomotive is now under construction for Imperial Chemical Industries (Lime), Ltd., of Buxton. For Roads Reconstruction, Ltd., of Bristol, a 100 H.P. oil-engined locomotive for working on main line gauge track is in hand.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/6 to 20/-
(1) Spanish	17/- to 22/6
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 8 6	—
No. 1 Foundry	3 12 0	—
No. 3 Foundry	3 9 6	—
N.E. COAST—		
Hematite Mixed Nos.	3 2 0	3 2 0
No. 1	3 2 6	3 2 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station*).	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 15 6 (*a*) 4 0 6 (*b*) 4 5 6 (*c*)	— — —

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	9 15 0	9 5 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	9 5 0	—
Best Bars	10 5 0	—
Double Best Bars	10 15 0	—
Treble Best Bars	11 5 0	—
LANCS.—		
Crown Bars	9 15 0	—
Best Bars	10 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	9 15 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 0 0 to 9 15 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 0 0 to 8 10 0	—
Gas Tube Strip	10 10 0	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
5) SCOTLAND—		
Boiler Plates (Marine)	9 0 0	8 10 0
„ „ (Land)	—	—
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 15 0	7 15 0
Sheets (Gal. Cor. 24 B.G.)	11 0 0	10 5 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	7 2 6	—
Soft Billets	5 10 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 3 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 15 0 to 7 0 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	8 10 0 to 8 12 6	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	5 15 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 10 0	—
MIDLANDS—		
Small Rolled Bars (all British)	7 5 0 to 7 15 0	—
Small Re-rolled Bars	6 7 6 to 6 10 0	—
Billets and Sheet Bars	4 17 6 to 5 7 6	—
Galv. Sheets, f.o.b. L'pool	9 5 0 to 9 7 6	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	8 7 6 to 8 10 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	15/0 to 15/6
Block Tin (cash)	125 15 0
„ (three months)	127 12 6
Copper (cash)	25 11 3
„ (three months)	25 3 9
Spanish Lead (cash)	9 7 6
„ „ (three months)	9 15 0
Spelter (cash)	11 5 0
„ (three months)	11 12 6
MANCHESTER—	
Copper, Best Selected Ingots	30 0 0
„ Electrolytic	30 10 0
„ Strong Sheets	59 0 0
„ Tubes (Basis Price), lb.	0 0 9½
Brass Tubes (Basis Price), lb.	0 0 8½
„ Condenser, lb.	0 0 11
Lead, English	11 10 0
„ Foreign	10 0 0
Spelter	11 10 0
Aluminium (per ton—raw ingot)	£95

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/9 per lb.	
Ferro Chrome, 4 p.c to 6 p.c. carbon	£25 0 0	8/-
„ „ 6 p.c. to 8 p.c.	£24 10 0	7/6
„ „ 8 p.c. to 10 p.c.	£23 15 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£37 0 0	11/-
„ „ „ 1 p.c. carbon	£47 0 0	14/-
„ „ „ 0·70 p.c. carbon	£48 0 0	16/-
„ „ „ carbon free	1/1 per lb.	
Metallic Chromium	2/9 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£13 10 0 scale 5/- per unit	
„ „ 75 p.c.	£19 0 0 scale 6/- per unit	
„ Vanadium	12/6 per lb.	
„ Molybdenum	6/3 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£250 to £255	
Ferro Cobalt	8/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/-
„ „ Ell	14/-
„ „ Splint	13/9 to 14/9
„ „ Trebles	12/6
„ „ Doubles	10/-
„ „ Singles	8/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	11/9
„ „ Jewel	16/6
„ „ Trebles	12/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/9 to 13/-
Screened Navigation	16/6
Trebles	13/6 to 15/6
Doubles	10/6 to 11/6
Singles	9/3
LOTHIANS—	
(f.o.b. Leith)—Best Steam	11/- to 11/6
Secondary Steam	10/6
Trebles	13/6
Doubles	10/6 to 11/-
Singles	8/9 to 9/-

(8) N.W. COAST— ENGLAND.

Steams	21/9
Household	32/6 to 51/8
Coke	19/- to 22/6
NORTHUMBERLAND—	
Best Steams	13/6
Second Steams	12/3 to 12/6
Steam Smalls	8/6
Unscreened	12/6 to 13/-
Household	27/- to 39/-
DURHAM—	
Best Gas	14/6
Second	13/3 to 13/6
Household	25/- to 37/-
Foundry Coke	24/-

SHEFFIELD—	Inland.	Export.
Best Hand-picked Branch	25/- to 26/-	—
South Yorkshire Best	20/- to 21/-	—
Derbyshire Best Bright House	20/- to 21/-	—
Screened House Coal	15/6 to 16/6	—
Best Screened Nuts	15/- to 16/-	—
Small Screened Nuts	13/6 to 15/6	—
Yorkshire Hards	16/- to 18/-	—
Derbyshire Hards	16/- to 18/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	7/- to 8/6	—
Blast-furnace Coke (Inland)	11/- to 12/- on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b., 14/6 to 16/6		

(9) SOUTH WALES.

CARDIFF—	Export.
Steam Coals:	
Best Smokeless Large	19/6 to 19/9
Second Smokeless Large	18/9 to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	17/9 to 18/3
Best Black Vein Large	18/3 to 18/6
Western Valley Large	17/9 to 18/-
Best Eastern Valley Large	17/7½ to 17/9
Ordinary Eastern Valley Large	17/3 to 17/6
Best Steam Smalls	13/- to 13/6
Ordinary Smalls	11/- to 13/-
Washed Nuts	19/- to 25/-
No. 3 Rhondda Large	19/6 to 19/9
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/6 to 36/6
Furnace Coke (Export)	17/- to 18/-
Patent Fuel	20/-
Pitwood (ex ship)	19/6 to 20/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	36/- to 38/6
Seconds	27/- to 32/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 48/6
Nuts	40/- to 48/6
Beans	28/6 to 32/6
Peas	19/6 to 21/-
Breaker Duff	8/6 to 9/6
Rubbly Culm	11/- to 11/6
Steam Coals:	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate: Joists (minimum), 22/6: Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Treaties of Commerce.

THE promise of early negotiations for a treaty of commerce between Great Britain and France has clarified the outlook, and raised hopes that many of the difficulties which stand in the way of international exchanges will be overcome shortly, when trade and industry will be able to look forward with confidence to better times. The financial troubles in Central Europe are a stumbling block to any general industrial revival, and must be removed. That result can only be achieved by collaboration between Great Britain and France, to be extended eventually to other countries, and there is a feeling now that European industry will soon start on the up grade. It is time that there was some turn of the tide, for all the attempts made in this country to avert a collapse—even the famous programme of public works, which is only being carried out very partially through shortage of funds—have failed. The engineering industries suffer more than others from economic depression. It is now seen that the only hope for the future lies in removing the barriers to international trade, and experience has shown the danger of initiating restrictions and reprisals which everyone admits must be abandoned. At the same time, there must be some regulation of exchanges, and it is the general opinion that the "most-favoured-nation treatment" must go, so that a fair arrangement may be come to with different countries for an interchange of those goods which particularly interest them. The French idea is that a settlement of commercial exchanges should be left to manufacturers and producers, with due regard to the interests of consumers.

European Federation of Engineers.

A committee has been formed to carry out the preliminary work of creating a European Federation of Engineers, and at an inaugural lunch in Paris last week, under the chairmanship of Monsieur Yves Le Trocquer, a former Minister of Public Works, the general lines of the proposed federation were explained. Monsieur A. Guiselin stated that a European organisation of engineers appeared to be "a practical necessity and a moral obligation," because its character was not only technical, but also economic and social. He believed that such a Federation would facilitate an interchange of ideas and initiative amongst engineers in different countries. They would be able to combine their efforts for international action, and help to solve economic problems with their technical knowledge. Nevertheless, he admitted that there were difficulties in the way of realising the scheme. Monsieur Le Trocquer believed that there was too much individualism in the engineering profession, and that it had become highly necessary to create a spirit of discipline amongst engineers. An informal discussion amongst the many prominent engineers present led to the suggestion that it would be better to begin by forming clubs in various countries, where engineers could consider the question amongst themselves, and then bring the clubs together to form the nucleus of a European Federation.

The Coal Industry.

A report has been issued by Monsieur P. Bernard, general secretary of the Chambre des Houilléres du Nord et du Pas de Calais, in which he describes the difficulties under which the coal industry is labouring in the North of France. The report insists upon the urgency of something being done to protect the industry and relieve it of some of the fiscal charges that prevent owners from meeting the competition of foreign coal. The output in the Nord and the Pas de Calais fell from 35,000,000 tons in 1930 to 32,868,000 tons in 1931, and the companies now have stocks amounting to something like 5,000,000 tons. Monsieur Bernard implies that the trouble is to be attributed partly to the strike in the British colliery industry in 1926, when other countries made up for the stoppage of supplies from Great Birtain by increasing their own production. After the strike, British coalowners fought for their trade in a way that made it very uncomfortable for Continental producers. It was not until Great Britain went off the gold standard that the situation became critical for coalowners on the Continent. In two years the average daily wage of men working at the face in French collieries was increased from 36·91f. to 43·75f., excluding a bonus of 2f. a day for families. Since the last quarter of 1930 there has been a reduction of about 12 per cent. In the Ruhr wages have undergone a reduction of 26 per cent., and in Belgium 29 per cent.; while the depreciation of sterling has meant a reduction of 32 to 38 per cent. in the cost of British coal in foreign markets. At the same time, the average daily production per man at the French collieries is declared to be about one-half of that in Poland and German, and two-thirds of the individual production in Great Britain. This smaller output per man is attributed to the depth and narrowness of the French coal seams. The mining companies therefore ask for measures of protection against imported coal, in order to compensate for the greater difficulties in coal getting.

Canal Traction.

The policy of developing the canal system in the North of France, with the object of accelerating the traffic of barges of bigger tonnage and bringing it into line with the inland waterways of Central Europe, has made great progress of late years, and many methods of mechanical and electrical haulage have been experimented with, the system finally adopted consisting of the use of tractors on rails with overhead trolleys taking current supplied by sub-stations about 12 miles apart. About 420 miles of canal have been equipped in this way. The work is being undertaken by the Office National de Navigation, which is in a fair way of creating a State monopoly of electric traction. This arrangement does not altogether satisfy the navigation companies and other barge owners, who fear that a monopoly will not be to their advantage. Many of them prefer a more general use of motor barges, especially where they have to pass on to inland waterways that are not electrified.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

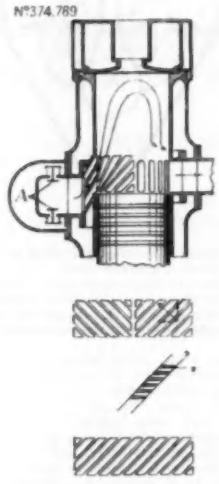
The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

374,789. December 21st, 1931.—ADMISSION PORTS FOR TWO-STROKE ENGINES, Sulzer Frères Société Anonyme, Winterthur, Switzerland.

This invention is concerned with the formation of the ports used to introduce scavenging air into the cylinders of two-stroke oil engines. These ports, as is shown in the drawing, have a

N°374,789



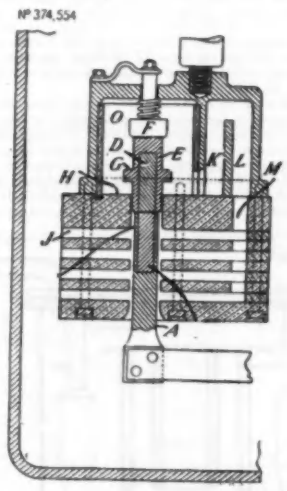
helical form, and are supplied by angular ducts, while the exhaust ports are parallel with the axis of the cylinder. The result is that the scavenging air is swept well up and round the cylinder space without being directly dissipated. It is noteworthy that non-return valves A are arranged in the supply of scavenging air.—*June 16th*, 1932.

SWITCHGEAR.

374,554. March 30th, 1931.—CIRCUIT INTERRUPTERS WITH CONTACTS IN OIL OR OTHER INSULATING LIQUID, William Anselm Coates, of St. Michaels, 165, Hale-road, Hale, Cheshire, and Associated Electrical Industries, Ltd., of Crown House, Aldwych, in the City of Westminster.

According to this invention, a floating part and the remaining portion of the movable member of a circuit breaker are held in contact during the first part of the opening movement by making portions of them of magnetic material and arranging that one or both of the portions shall be magnetised. The interrupter is opened by withdrawal of the actuable portion A of the moving contact. Owing to the magnetic attraction of the inset parts G and D, the floating contact portion E moves with the portion A of the moving contact during the initial stage of the opening

N° 374,554



operation of the circuit interrupter, the break taking place at the surfaces of the fixed contact F and the floating contact E. Upon engagement of the collar or stop G of the floating contact portion with the wall H, the floating contact portion E is prevented from following the actuable portion A, so that at this stage a second break takes place. The circuit interrupter is so designed that the contact surfaces between the actuable contact portion A and the floating contact portion E are opposite the first of the transverse channels J, when the break at these surfaces occurs. The gas bubble which is formed in the explosion chamber due to the separation of the contacts E and F forces oil from the reservoir K into the chamber L and through the duct M and the channels J, so that, when the contacts E and F separate, a relatively large body of oil is forced across their contact surfaces.—*June 16th*, 1932.

TRANSFORMERS AND CONVERTERS.

375,057. June 4th, 1931.—ELECTRIC TRANSFORMER CORES, Ferranti, Ltd., of Hollinwood, and Eric Douglas Tobias Norris, of the same address.

In electrical transformers the maximum width of core plate which may be used is limited by the following considerations:—(1) The voltage per inch across the insulation between plates is proportional to the width of the plate; (2) the temperature gradient in the core depends largely on the width of plate, as only a small proportion of the heat flow can occur in a direction at right angles to the plates, owing to the low thermal conductivity of the insulation, and (3) the difficulty in making interleaved joints in a core without damaging the plate insulation increases with the area of joint overlap. If the cross-sectional area of core necessary in a large transformer is such that the dimension in the plane of the laminations exceeds the maximum width of plate allowable, the core must be split transversely to that plane into parts in which the allowable width of plate is not exceeded. Previous methods of core-splitting in three-phase transformers have introduced difficulties in core assembly and clamping owing to the yokes and the core legs having to be split. The object of the invention is to provide transformer cores wherein these difficulties are minimised or eliminated.

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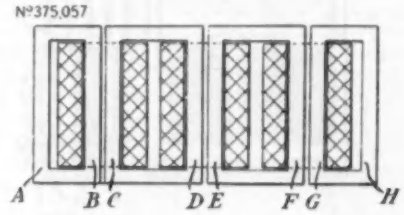

Four simple two-legged core elements A B, C D, E F, G H are placed close to each other in one plane so that adjacent legs of every pair of adjacent core elements are mutually separated. The legs B C, D E and F G form the three main legs, while the first and fifth legs are constituted by the legs A and H. The cross-sectional area of all the legs of the core elements is the same, and thus the three main legs of the transformer core have twice the effective cross-sectional area of the remaining two legs A H as is usual in five-leg transformer cores. The width of plate used to constitute the core elements is only half that necessary for an unsplit transformer core having the same cross section of iron in the main legs, and, although only half the iron in any one leg is linked directly with that in another leg, the additional unwound legs provide alternative paths for the necessary flux and obviate excessive flux densities in portions of the core or in the spaces between them.—*June 23rd*, 1932.

MEASURING AND TESTING INSTRUMENTS.

374,779. November 30th, 1931.—PYROMETERS, *the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

This instrument depends for its readings on the ionisation of air at high temperatures. It comprises two or more electrodes A A of silicon carbide, which are separated by glass spacers at the ends. These ends protrude from the furnace of which the

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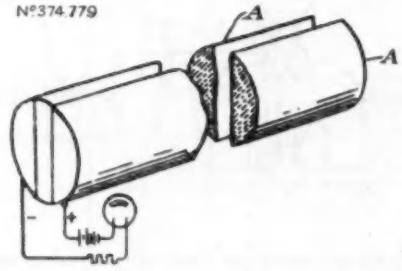

temperature is to be measured, so that the glass is not damaged by the heat. A battery and a delicate ammeter are connected across the electrodes. At temperatures up to about 1200 deg. Cent. the air between the electrodes acts as a good insulator, and no current flows through the circuit. Above that temperature the air becomes ionised and, consequently, conductive to a greater or less degree. A current then flows through the circuit and can be used to measure the temperature.—*June 16th*, 1932.

TRANSMISSION OF POWER.

375,091. July 10th, 1931.—FLUID FLY-WHEELS FOR MOTOR CARS, the Daimler Company, Ltd., and L. H. Pomeroy, Daimler Works, Coventry.

This invention has relation to the Föttinger type of fly-wheel, or clutch, which embodies a hydraulic transmission of the torque of the engine through the fly-wheel. It is pointed out in the specification that it is usual to employ two universal joints in the shaft between the fly-wheel and the gear-box. One of

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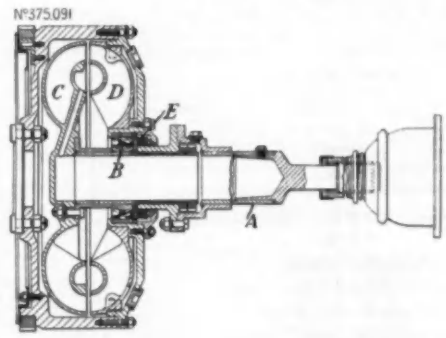


these joints is, however, eliminated, according to the specification, as it has been found that the maintenance of a precise clearance between the two parts of the transmitter has little effect on its efficiency. As a consequence, the shaft A is allowed to adjust itself in the self-aligning bearing B, and the rotor C may not be truly parallel with the rotor D without materially impairing the efficiency of the apparatus. A metallic bellows is provided at E to make an oil-tight joint.—*June 23rd*, 1932.

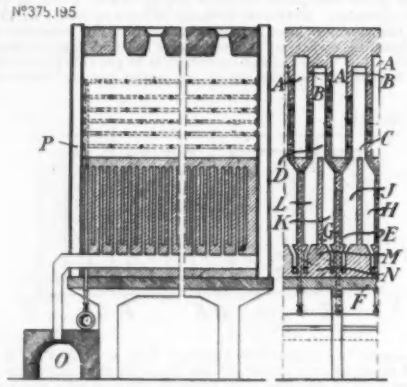
GAS PRODUCERS.

375,195. November 24th, 1931.—TWIN FLUE CHAMBER OVENS, *W. W. Groves, 30, Southampton-buildings, London, W.C. 2.*

It is claimed that with an oven constructed in this way a very substantial structure is obtained, which will not be deformed by

the expansion due to heat. A represents the oven chambers, which in the usual manner are disposed between the heating walls B. Each heating wall is subdivided into a plurality of twin heating flues C and D, of which, owing to the recuperative heating, only the flues C convey the incandescent gases. Under each oven chamber there is a strong gas-tight supporting wall E, which is continued at a uniform thickness on one side along the whole length of the oven, and also from the bottom F of the oven to the sole of the chamber. Continuous longitudinal walls

N°375,195



G are disposed between the supporting walls E centrally below the heating walls B. The gas and air recuperators H and J are in communication with the flues C, the recuperator compartments K and L with the flues D. The waste heat compartments K communicate with the passages M in the sole and the waste heat compartments L with the passages N in the sole which are connected over regulating devices communicating with the passage O to the chimney. Buckstays P, disposed in the extension of the longitudinal wall G, serve for tieing firmly together the brickwork of the oven.—*June 23rd*, 1932.

PUMPING AND BLOWING MACHINERY.

374,636. June 17th, 1931.—MEANS FOR PROTECTING HYDRAULIC CONTROL CLUTCHES, W. Voith, H. Voith and H. Voith, Heidenheim, Brenz, Würtemburg, Germany.

The centrifugal pump A is connected with its driving turbine by the hydraulically operated clutch B. If the pump is delivering into a long pipe line it is important that it should not be accidentally declutched. The normal hydraulic supply for operating the

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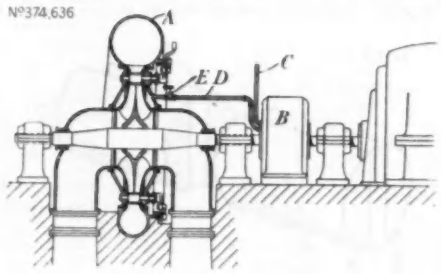

clutch is taken from the pipe C and can be controlled manually as desired. In order to protect the clutch against being accidentally opened, by the failure of the supply by the pipe C, there is a secondary supply D from the clearance space of the pump. This supply includes a valve E, which is so interconnected with the control of the pump that pressure cannot be lost at the clutch when the pump is working on the pipe line.—*June 16th*, 1932.

MACHINE TOOLS AND SHOP APPLIANCES.

374,635. June 17th, 1931.—COOLING CENTRIFUGALLY CAST HOLLOW BLOOMS, Mannesmannröhren-Werke, 1B, Berger Ufer, Düsseldorf, Germany.

This invention is concerned with the cooling of hollow cast "blooms," which are cast in a vertical centrifugal mould. In order to expedite production, it has been the practice to cool

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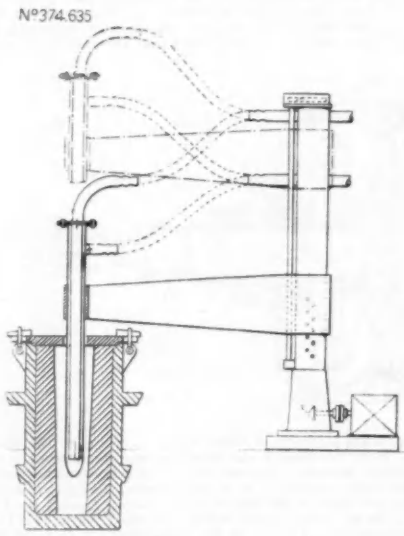

the interior of the bloom by the circulation of liquid, or gaseous, media, but it has been found that the actual contact of such media is liable to affect the qualities of the metal when it is in the liquid state. As a consequence, the inventors effect the cooling by radiation by means of a tube through which water is circulated. This tube is lowered into the mould by the mechanism shown.—*June 16th*, 1932.

MISCELLANEOUS.

374,795. January 1st, 1932.—CENTRIFUGALLY PURIFYING GASES, VAPOURS AND STEAM, W. Alexander, 1, Broomhill-avenue, Partick West, Glasgow.

The primary object of this invention seems to be a division of that part of the cyclone which is directly concerned with the separation process, from that in which the dust or other foreign

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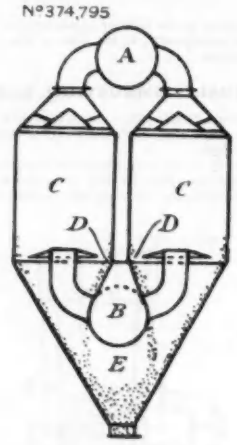

matter is precipitated. The contaminated air is supplied to the apparatus by the duct A and the clean air evacuated at B. The dirty air is brought into the chambers C, C, tangentially to produce a centrifugal effect and the solid matter thus separated out falls through openings D, D, into the hopper E below, from which it is discharged as occasion may demand.—*June 16th*, 1932.

374,861. January 10th, 1931.—HARMONIC FILTERS FOR USE ON ALTERNATING-CURRENT CIRCUITS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2, and Reginald Thornton Coe, of "Brandreth," Dunchurch-road, Rugby.

The polyphase power transformer shown has its delta-connected primary winding connected to the circuit from which a harmonic is to be absorbed and its star-connected secondary winding connected to condensers A, which are also arranged in star. The inductance due to the leakage flux, together with the condensers, is utilised for tuning each branch of the filter

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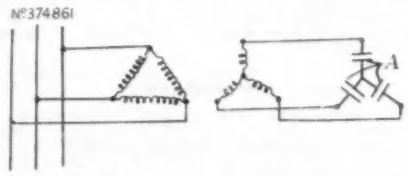

circuit to the desired harmonic. It will be understood that the primary and secondary winding of the transformer and condensers may be connected in star or delta as may be most convenient. Where the transformer as designed does not give exactly the reactance required a tuning adjustment may be provided consisting of tappings on the transformer. One advantage claimed for the invention is that in the case of high-voltage circuits, the transformer can be used to transform the voltage down to a lower value more suited to the operation of the condenser, as well as supplying the inductive reactance necessary for tuning.—*June 10th*, 1932.

374,909. February 12th, 1931.—MERCURY VAPOUR RECTIFIERS FOR HIGH OUTPUTS, *Leonard Mellersh-Jackson, of Haseltine, Lake and Co., 28, Southampton-buildings, Chancery-lane, London, W.C. 2.*

The object of this invention is to improve the conditions of flow of vapour in mercury arc rectifiers. Above the cathode there are cylindrical cooling bodies. Through these cooling cylinders, comprising an inner cylinder A and an outer cylinder B, the superheated mercury vapour generated at the cathode rises vertically. The coolers extend as closely as possible to the cathode, so that they may take up, as completely as possible, the superfluous mercury vapour and only leave free the necessary

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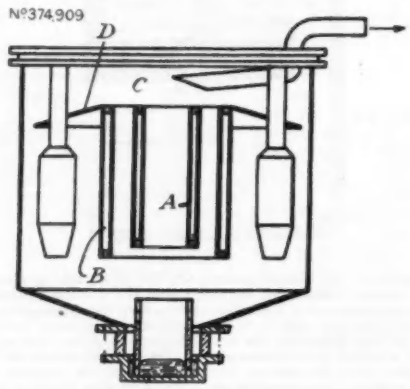

path for the arc directed towards the anodes. The cooling cylinders A and B are so dimensioned that they do not condense the superheated vapour rising from the cathode, but only bring the vapour to the saturation temperature and pressure. Above these cooling cylinders there is the condensation chamber C proper. Here the vapour is afforded an opportunity of spreading itself out in spaces in which there are cooling surfaces, which are so dimensioned that the saturated vapour will be condensed thereon. The condensate formed in the condensation chamber is kept away from the anode chamber by diverting surfaces D.—*June 13th*, 1932.

375,193. November 23rd, 1931.—STEAM VALVES, Sir John Dewrance, 165, Great Dover-street, Southwark.

In this valve the cover is inserted in the body like the manhole cover of a boiler, and is held in place by two bridge pieces. The spindle is fitted into the valve wedge by means of a bayonet joint, so that it can be withdrawn and then, with the bridge

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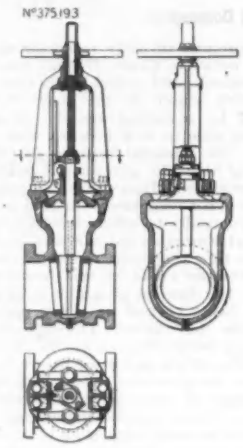

pieces dismantled, and the spindle bridge taken off, the cover can be removed.—*June 23rd*, 1932.

375,109. July 29th, 1931.—ELECTRIC INSULATORS, *the British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2.*

The insulator described in this specification consists of a hollow body composed of porcelain or similar material and having upper and lower sections, one section being adapted for the reception of a support and the other for carrying the conductor. Thus, there are two layers of dielectric material, and

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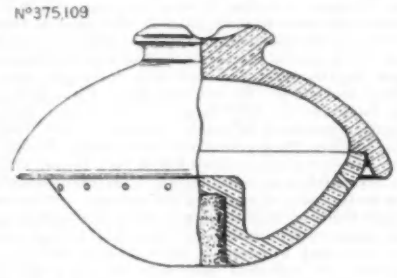

an air chamber lie between the conductor and the support. As shown in the illustration, the upper section overlaps the lower section, and the air chamber is in restricted communication with the atmosphere so as to prevent the entrance of water. The general object of the invention, the specification states, is to provide a "radio proof" insulator in which there will be the effect of three or more condensers in series, one of which is of such low capacitance as to be capable of carrying most of the voltage under normal line conditions.—*June 23rd*, 1932.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Tuesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

WEDNESDAY, JULY 27TH.

CRYSTAL PALACE SCHOOL OF PRACTICAL ENGINEERING.—179th award of certificates. Sir Cyril R. S. Kirkpatrick will present certificates. 3 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—Excursion and visit to the works of the Derbyshire Silica Fire Brick Company, Ltd. Depart Manchester by motor coach, 1.30 p.m.

WEDNESDAY, AUGUST 31ST, TO WEDNESDAY, SEPTEMBER 7TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—Annual meeting at York. President, Sir J. Alfred Ewing, F.R.S. Particulars may be obtained on application to the secretary, British Association, or to the hon. local secretaries, British Association, The Guildhall, York.

SATURDAY, SEPTEMBER 24TH.

ALL-BRITISH EXHIBITION.—Copenhagen, Denmark. Opening.

THE WHITWORTH SOCIETY.—The summer meeting of the Whitworth Society was held in Birmingham on July 14th and was attended by nearly fifty members. The party left the Imperial Hotel at 9.15 a.m. in motor coaches for the Soho Works of W. and T. Avery, Ltd., where the members inspected the old portion previously occupied by Boulton and Watt and examined the various relics of James Watt. They subsequently inspected the manufacture of various classes of weighing and testing machines. Lunch was provided and the chair taken by Professor Martineau, late of Birmingham University. Subsequently the President, Professor F. C. Lea, of Sheffield University, inducted the President-elect, Professor D. A. Low, Emeritus Professor of Engineering at East London College, London University. The party left for the General Electric Company's works at Witton, which covers 120 acres and employs 6500 people, being about one-quarter of the total number employed by the company. The party inspected large rotary converters, steam turbines, transformers, &c., in progress in the works. Later the party returned by motor coach to Birmingham and dispersed. Details of the Society and its activities may be obtained from the Hon. Secretary, Whitworth Society, c/o Institution of Mechanical Engineers, Storey's-gate, Westminster, S.W. 1.